EFFECTIVENESS OF CLOSED ENDOTRACHEAL SUCTIONING AS AGAINST OPEN ENDOTRACHEAL SUCTIONING UPON RESPIRATORY OUTCOME IN MECHANICALLY VENTILATED ADULT PATIENTS

BY

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A DISSERTATION SUBMITTED TO THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY, CHENNAI, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN NURSING

APRIL 2013

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DECLARATION

I hereby declare that the present dissertation entitled **"Effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients"** is the outcome of the original research work undertaken and carried out by me under the guidance of **Dr. Latha Venkatesan,** M.Sc (N)., M.Phil (N)., Ph.D (N), Principal, Apollo College of Nursing, and **Mrs. Jaslina Gnanarani .J,** M.Sc (N)., Reader, Medical Surgical Nursing Department, Apollo College of Nursing, Chennai. I also declare that the material of this has not found in any way, the basis for the award of any degree or diploma in this university or any other university.

M.Sc (N) II Year

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SYNOPSIS

An Evaluative Study to Assess the Effectiveness of Closed Endotracheal Suctioning as Against Open Endotracheal Suctioning upon Respiratory Outcomes in Mechanically Ventilated Adult Patients at Selected Hospitals, Chennai.

The Objectives of this Study are,

1. To assess the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
2. To determine the effectiveness of method of endotracheal suctioning by comparing the respiratory outcome before and after closed and open endotracheal suctioning in mechanically ventilated adult patients.
3. To assess the level of satisfaction of nurses regarding closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
4. To assess the level of practice of nurses on closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
5. To find out the association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
6. To find out the association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

The conceptual framework for the study was developed on the basis of Wiedenbach's Helping Art of Clinical Nursing Theory (1964), which was modified for the present study. An intensive review of literature and experts guidance laid the foundation to the development of tools such as demographic variable proforma, clinical variable proforma for patients, respiratory outcome check list, nurse satisfaction rating scale and practice of nurses check list.

In this study an evaluative research design was adopted with two intervention group pre and post test design was adopted for nurses. The present study was conducted at Apollo Speciality Hospital and Apollo Main Hospital, Chennai among mechanically ventilated adult patients with closed and open endotracheal suctioning. The study sample size for the present study was 100 mechanically ventilated adult patients. Among the 100 patients 50 patients were assigned to closed endotracheal suctioning (CES) and 50 patients were assigned to open endotracheal suctioning (OES) who satisfied the inclusion criteria.

The investigator used the demographic variable proforma for patients, clinical variable proforma for patients to obtain the baseline data. Observational checklist was used to assess the respiratory outcome, checklist on practice of nurses was used to find the compliance of nursing practice and rating scale to assess the level of satisfaction of nurses. The data collection tools were validated and reliability was established. After the pilot study, the data collection of the main study was conducted for a period of four weeks. The collected data was tabulated and analyzed by using appropriate descriptive and inferential statistics.

The Major Findings of the Study

- Majority of the mechanically ventilated adult patients in closed and open endotracheal suctioning were aged between 51-60years (52%, 46%), male (64%, 68%), employed (44%, 46%), indoor worker (66%, 60%), sedentary workers (56%, 58%), both history of smoking (24%, 26%) and alcoholism (30%, 20%) respectively.
- Most of the mechanically ventilated adult patients in both closed and open endotracheal suctioning in this study were diagnosed to have neurological disease (34%, 60%), ventilated for trauma/shock (28%, 36%), overweight (42%, 50%), 1 to 3 days of ventilation (64%, 80%), consciousness (56%, 42%), required physiotherapy (56%, 28%), humidifier (40%, 14%), patient received nebulization (64%, 40%), previous history of respiratory illness (16%, 6%), patient with co-morbid illness (52%, 52%), treatment for co-morbid illness (54%, 50%), had history of trauma (12%, 28%) and surgery (28%, 24%) respectively.
- Mean and standard deviation in the respiratory outcome of the mechanically ventilated adult patients before performing closed and open endotracheal suctioning was (M=33.07, 33.53 & SD= 4.49, 3.94) where as there is a significant decline at the time of suction (M=28.3, 25 & SD= 4.53, 4.41). The mean and standard deviation of post suction respiratory outcome after 15min was high in closed and open endotracheal suctioning (M= 34.07, 34.2 & SD= 4.66, 4.29) respectively.

- There is a significant difference ($p<0.001$) in the respiratory outcome during suction between CES and OES ($t=3.69$). Hence, the null hypothesis Ho_1 was rejected.
- Vital signs was within normal limits in closed endotracheal suctioning (CES) during suction (mean 7.27, SD 1.59) while comparing with the open endotracheal suctioning (OES) (mean 6.98, SD 1.73), sign of respiratory distress was less in CES (mean 9.35, SD 2.40) while comparing with the OES (mean 8.97, SD 2.40), in ventilator settings CES (mean 5.5, SD 1.07) was better than the OES (mean 2.28, SD 0.67). But with regard to sign of infection OES (mean6.88, SD 2.05) was lesser than CES (mean6.13, SD 2.76). There was a significant difference ($p<0.001$) in ventilator setting during suction in between the groups ($t=3.65$).
- The study result indicates that 16% of nurses were highly satisfied with CES 72% were satisfied and 12% were dissatisfied. In OES 12% nurses were highly satisfied, 62% were satisfied and 26% were dissatisfied.
- The present study reveals that in CES 26% of nurses had good performance skill, 72% of nurses had average performance skill and only 2% nurse had a poor performance. Majority of nurses had average performance (88%) and 4% had poor performance in OES.
- Chi square test was used to find out the association between selected demographic variables and the respiratory outcome, inferred that there was no significant association between the respiratory outcome and the selected demographic variable ($p>0.05$). In this regard, the null hypothesis Ho_2 was retained.

- There was a significant association between the respiratory outcome and the selected clinical variables of body mass index (χ^2=8.01, df=1), (p<0.01), number of days on ventilator (χ^2=11.22, df=1), (p<0.001), humidifier (χ^2=4.32, df=1), (p<0.05) before suction and diagnosis (χ^2=9.52, df= 4), (p<0.05), reason for mechanical ventilation(χ^2=11.71, df= 3), (p<0.05) , body mass index (χ^2=6.63, df= 1), (p<0.01), number of days on ventilator (χ^2=8.6, df=1), (p<0.01), humidifier (χ^2=5.3, df=1), (p<0.05) after suction in closed endotracheal suctioning.

- There was a significant association between the respiratory outcome and the selected clinical variables of alertness (χ^2=5.05, df= 1), (p<0.05), number of days on ventilator (χ^2=3.92, df=1), (p<0.05), history of trauma (χ^2= 5.50, df=1), (p<0.01) before suction and history of trauma (χ^2= 4.72, df=1), (p<0.05) after suction in open endotracheal suctioning. Hence, the null hypothesis Ho_3 was partially rejected.

Recommendations

- A study can be conducted on infection precautions in closed and open endotracheal suctioning system among mechanically ventilated adult patients.
- Study can be conducted to assess the incidence of ventilator associated pneumonia (VAP) in closed and open endotracheal suctioning system among mechanically ventilated adult patients.
- Study can be conducted on cost effectiveness in closed and open endotracheal suctioning system among mechanically ventilated patients.

- Study can be conducted to assess the various other problems in mechanically ventilated patients.
- A study can be conducted for tracheal closed and open endotracheal suctioning patients.
- A similar study can be done on mechanically ventilated preterm neonates
- A similar study can be done on a larger population for more valid generalization.
- The study can be conducted in the other settings like the community and the hospitals.

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CHAPTER I

INTRODUCTION

Background of the Study

"For breath is life, and if you breathe well, you will live long on earth"

–Sanskrit Proverb

Breathing is the greatest pleasure in life. Breath is spirit; the act of breathing is living. Breath is the bridge which connects life to consciousness, which unites your body to your thoughts. Airway management is the process of ensuring that there is an open pathway between a patient's lungs and the outside world and the lungs are safe from aspiration. The primary purpose of airway management is to provide a continuously open airway along a continuous source of oxygen. An obstructed airway means that the body is deprived of oxygen. If ventilation is not reestablished, brain death will occur within few minutes.

When a patient is critically ill and requires an artificial airway and mechanical ventilation, it is the responsibility of the health care professionals caring for the patient ensures that the airway is secure. Airway management is an important priority for critically ill patients. Prolonged endotracheal intubation has become the standard of care in most of the intensive care unit (ICU). Around 2.7% episodes of mechanical ventilation occur per 1000 patient population getting admitted in the intensive care unit. Unfortunately this approach is associated with significant mortality and morbidity.

The 2005, critical care safety study, supported by the agency of health care research and quality found that adverse effect in intensive care unit occurs at a rate of 81 per 1000 patient days. Nearly half (45%) of the adverse events in intensive care unit are

preventable. Nurses hold the accountability for patient outcome. The care of the mechanically ventilated patient is a fundamental component of a nurse's clinical practice in the intensive care unit (ICU). Not only in the aspect of treating illness also in every possible measures that will promote the comfort and enhance physiological response in the body.

Esteban A.et al. (2002) did a prospective cohort study in 361 intensive care units among adult patients who received mechanical ventilation and they measured the mortality cause during intensive care unit stay. Overall mortality rate in the intensive care unit was 30.7% out of 15757 patients. 52% in patients who received mechanical ventilation because of acute respiratory distress and 22% in patients received for chronic obstructive pulmonary disease. Survival rate of patients receiving mechanical ventilation for more than 12 hours was 69%.

The normal respiratory function of the mechanically ventilated patient is compromised placing them at risk of complications. Artificial airways bypass the humidification and filtering mechanisms of the upper airways (St John and Malen, 2004), oxygen is cold and dry and disease processes and therapies can impair the cough reflex (Jaber et al. 2004). Lung secretions should be assessed for colour, consistency and volume (Winters and Munro. 2004). The need to monitor the patient very closely for any signs and symptoms of complication also arises.

Suction is a rather frequent and essential procedure in patients under mechanical ventilation. Reports indicate that each patient undergoes suction for about 8 to 17 times a day. During the procedure endotracheal secretion is removed to assure adequate

oxygen supply and to avoid obstruction of the tube lumen, resulting in increased respiratory work, atelectasis and pulmonary infections. However, there are also adverse effects such as alteration of the heart rate, hypoxemia and ventilator associated pneumonia (VAP).

Suctioning is not a benign procedure and adverse physiological effects directly attributed to airway suction are well documented. These effects can be both immediate and long term. Nurses are essential members of the multidisciplinary team and often spend the highest proportion of time with patients. Published work relating to the numerous nursing issues of the care of mechanically ventilated patient in the ICU is growing significantly, yet is fragmentary by nature.

Maggiore SM. et al. (2002) conducted a study to assess the effectiveness of alternative closed suction system included in the ventilator circuit. They suggested that it is helpful in limiting environmental, personnel and patient contamination and in preventing the loss of lung volume associated in the severely hypoxemic patients. Therefore, the correct choice of suction system is based on handling and the cost. The choice of suctioning system (closed vs. open) remains unresolved in evidence-based guidelines.

The purpose of study was to replicate and extend the existing body of knowledge pertaining to the normal relationship between suctioning and respiratory outcome. The aim of the study is to investigate the influence of suctioning on respiratory outcome. Thus the researcher decided to conduct the study to evaluate the effectiveness of closed and open suctioning technique upon respiratory outcome.

Need for the Study

The care of mechanically ventilated patient is at core of a nurse's clinical practice in the intensive care unit (Couchman B.A. et al.). Suctioning is a fundamental nursing activity. The nursing management of the mechanically ventilated patient is challenging on many levels: from the acquisition of highly technical skills; expert knowledge on invasive monitoring; and implementation of interventions to care for the patient. Each critically ill patient brings the clinical rationale for mechanical ventilation and additional complexities associated with their illness.

Intubated patients may be unable to adequately cough up secretions. Endotracheal suctioning is therefore important in order to reduce the risk of consolidation and atelectasis that may lead to inadequate ventilation. Overall mortality rate in ICU is about 37%. The study conducted by Ralf Peter Vonberg et.al. (2006) included a nine trials in which VAP occurred in 20% of the open suction group and 19% in the closed suction group (relative risk is 0.95).

In United States, the changing epidemiology of mechanical ventilation, a population based study was conducted by Carson C. Cox E.C. et.al. The incidence of mechanical ventilation grew from 284/100 000 population in 1996 to 314/100 000 in 2002, an increase of 11% ($P < 0.05$). While patients aged >64 had the highest age-specific incidence of mechanical ventilation each year, the greatest increase in incidence occurred in younger age (19% increase for age 18-64 versus 4% increase for age >64).

The proportion of patients discharged to home declined from 45.4% to 34.4%, and discharges to nursing homes grew from 7.3% to 10.7%. The incidence of mechanical ventilation is increasing, which is associated with a higher burden of comorbidities and fewer discharges to home.

Another study in US predicted the prolonged acute mechanical ventilation(MV) and hospital bed utilization in 2020 suggest that out of 605,898 cases, they will require 3.6 (95% CI 2.7–4.8) million MV, 5.5 (95% CI 4.3–7.0) million ICU and 10.3 (95% CI 8.1–13.0) million hospital days, representing an absolute increase of 2.1 million MV, 3.2 million ICU and 6.5 million hospital days over year 2000, at a total inflation-adjusted cost of over $64 billion. Expected discharges to skilled nursing facility are 218,123 (95% CI 177,268–266,739), compared to 90,928 in 2000. Such growth requires careful planning efforts and attention to efficiency of healthcare delivery.

A study conducted by Sudarsanam T.D. et.al (2005) predicted the mortality rate in mechanically ventilated patients in south India for a period of 12 months. The overall case fatality for patients admitted in the MICU was 148 of 483 (30.6%). Of the 483 patients 283 patients did not require mechanical ventilation; five (1.7%) of these patients died. Two hundred patients were enrolled in the study. Sixty three (28.5%) were women and 137 (68.5%) were men. Of the 200 patients 143 (71.5%) died and 57 (28.5%) survived.

A meta-analysis done by Harada N. (2010) determines the efficacy and effectiveness of the closed suctioning system. The reviewed recent studies reveal that closed suctioning systems are no better than open suctioning systems in terms of

mortality, morbidity, or the cost benefit ratio. A few studies indicate that the closed suctioning system might reduce the loss of lung volume and oxygen desaturation. There is a need for further studies with randomized control trials to explore the use of closed suction systems and to update current clinical practice guidelines.

Evaluation research is an applied form of research whose methodologies have evolved within such fields as education and public policy. Evaluation research focuses on developing useful information about a program, practice, procedure or policy-information that is needed by decision makers about whether to adapt, modify, or abandon a practice or program.

Over the past 30 years, nursing care and health systems have undergone significant changes in many aspects. Particularly in the last decade, research and the expansion of evidence based practice have played a significant role in this process. Nursing care will have a considerably greater impact if evidence based care is applied. The study will provide guidance for practicing the suctioning in the clinical set up for nurses as a evidence based practice. Hence the investigator felt the need of the study.

Statement of the Problem

An Evaluative Study to Assess the Effectiveness of Closed Endotracheal Suctioning as Against Open Endotracheal Suctioning upon Respiratory Outcomes in Mechanically Ventilated Adult Patients at Selected Hospitals, Chennai.

Objectives of the Study

1. To assess the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
2. To determine the effectiveness of method of endotracheal suctioning by comparing the respiratory outcome before and after closed and open endotracheal suctioning in mechanically ventilated adult patients.
3. To assess the level of satisfaction of nurses regarding closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
4. To assess the level of practice of nurses on closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patient.
5. To find out the association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
6. To find out the association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Operational Definitions

Effectiveness

In this study, effectiveness refers to the desired changes in respiratory outcome after closed and open endotracheal suctioning as measured by respiratory parameters (Oxygenation, respiratory rate, normal breath sounds, use of accessory muscles, FiO_2

(Fraction of inspired oxygen), PIP (Peak inspiratory pressure), tidal volume, normal breath sounds, PaCO2, PaO_2, blood pressure, heart rate, number of days on ventilator, temperature, secretion characteristics and ET culture).

Closed endotracheal suctioning (CES)

In this study, it refers to closed suction (CS) by insertion of a device into the ventilator circuit that permits a suction catheter to be passed through a one-way valve into the endotracheal tube without disconnecting the patient from the ventilator.

Open endotracheal suctioning (OES)

In this study, it refers to open method (OS) of removal of secretions from the airway involves disconnecting the ventilator circuit and passing a sterile suction catheter into the endotracheal tube.

Respiratory outcome

In this study, the desired change in respiratory outcome means patient achieves respiratory parameters within normal limits. The parameters will be assessed for 3 consecutive days.

Oxygenation - 95-100%

Respiratory rate- 20-30 breaths/min

Breath sounds- normal breath sounds

Use of accessory muscle- no

FiO - 40%

Tidal volume- 4- 8ml/kg

PIP- 20cmH_2O

PaO_2- 90-100mmhg

$PaCO_2$- 35-45mmhg

Blood pressure- 120/80mmhg

Heart rate- 70-90beats/min

Number of days in ventilator- minimal days (3-5 days)

Temperature- 98.4degree F

Secretion characteristics- normal

ET culture- negative

Ventilated patient

In this study, it refers to the patient who is in mechanical ventilator support for 5 days.

Assumptions

The study assumes that:

- Ventilated patient need to be suctioned at frequent interval
- Suctioning will promote airway clearance thereby it enhances the respiratory outcome
- Suctioning will alter the respiratory physiology.

Null Hypothesis

Ho_1 There will be no significant difference in respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Ho_2 There will be no significant association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Ho_3 There will be no significant association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Delimitation

The study will be limited to the patients who are

- On mechanical ventilator support for minimum of 10 days
- Hemodynamically stable
- Admitted in intensive care unit
- Limited to 4 weeks

Conceptual Framework for the Study

The conceptual framework deals with the interrelated concepts that are assessable together in some rational scheme by virtue of their relevance to a common theme (Polit and Beck, 2010).

The conceptual framework of present study is based on Wiedenbach's Helping Art of Clinical Nursing Theory (1964). Ernestine Wiedenbach proposed a prescriptive theory for nursing, which was described as conceiving of a desired situation and way to attain it. This theory views nursing as an art based on a goal. It consists of three factors- central purpose, prescription and realities.

The conceptualization of nursing practice according to this theory consists of three steps.

Step 1- Identification

Step 2- Ministration

Step 3- Validation

Identification

The investigator identified the need for airway clearance in patient with endotracheal tube, by assessing the presence of copious secretion in the endotracheal tube, adventious breath sounds on auscultation, recurrent cough, increased airway resistance and decreased saturation.

Investigator assesses the closed and open endotracheal suctioning for mechanically ventilated adult patients by reducing length of stay, preventing complications, improving respiratory outcome and assessing the level of satisfaction of nurses. The investigator also assessed the practice of nurses while performing the suctioning for mechanically ventilated adult patients.

Ministration

Ministration is providing the needed help. In ministering, the nurse performs the closed and open endotracheal suctioning procedure. It has the following two components:

- Prescription
- Realities

Prescription

Prescription refers to the plan of performing the suctioning procedure after assessing the need. A prescription may indicate the broad general action appropriate to the implementation of the basic concept as well as suggest the kind of behavior needed to carry out these actions in accordance with the central purpose.

In this study, prescription refers to the performance of current and modified endotracheal suctioning technique for clearing the tracheo bronchial secretions. This

include assessing the respiratory outcome for mechanically ventilated adult patients after closed and open endotracheal suctioning for 3 consecutive days.

Realities

Realities are the situation that influences the fulfillment of central purpose. Wiedenbach defined five realities as:

- **Agent**

  The agent, the practicing nurse or delegate is characterized by the personal attributes, capacities and competencies in nursing. In this study, the investigator was the agent.

- **Recipient**

  The recipients, the patient are characterized by the personal attributes, problems and inability to cope with the concerns or problems being experienced. Patients who are mechanically ventilated were the recipients in this study.

- **Goal**

  The goal is the desired outcome of the expected wishes to achieve. The goal is the end result to be attained by the nursing action. Goal in this study is to improve the respiratory outcome after the closed and open endotracheal suctioning and find the effectiveness of closed endotracheal suctioning over open endotracheal suctioning in terms of oxygenation, respiratory rate, normal breath sounds, use of accessory muscles, FiO_2, PIP, tidal volume, PaCO2, PaO_2, blood pressure, heart rate, number of days on ventilator, temperature, secretion characteristics and ET culture.

- **Means and activity**

  It comprises of the activities and devices through which the practitioner is enabled to attain her goal. It includes the skills, techniques, procedures and devices that may be used to facilitate care.

  In this study, means and activity refers to assess the respiratory parameters after closed and open endotracheal suctioning with the use of checklist and observing the nursing practice through checklist.

- **Framework**

  Framework consists of human, environmental, professional and organizational facilities that not only make up the context with in which nursing is practiced but also constitute its currently existing limits. Framework of this study was in Apollo Main Hospitals and Apollo Speciality Hospitals, Chennai.

Validation

It refers to the collection of evidence that showed the effectiveness of both closed endotracheal suctioning and open endotracheal suctioning in view of respiratory outcome. It includes the practice checklist of nurses, respiratory outcome checklist and rating scale was used to assess the satisfaction of nurses. Validation was done by analyzing the attainment of central purpose. The long term goal is providing the best endotracheal suctioning method to patients in mechanically ventilated patients.

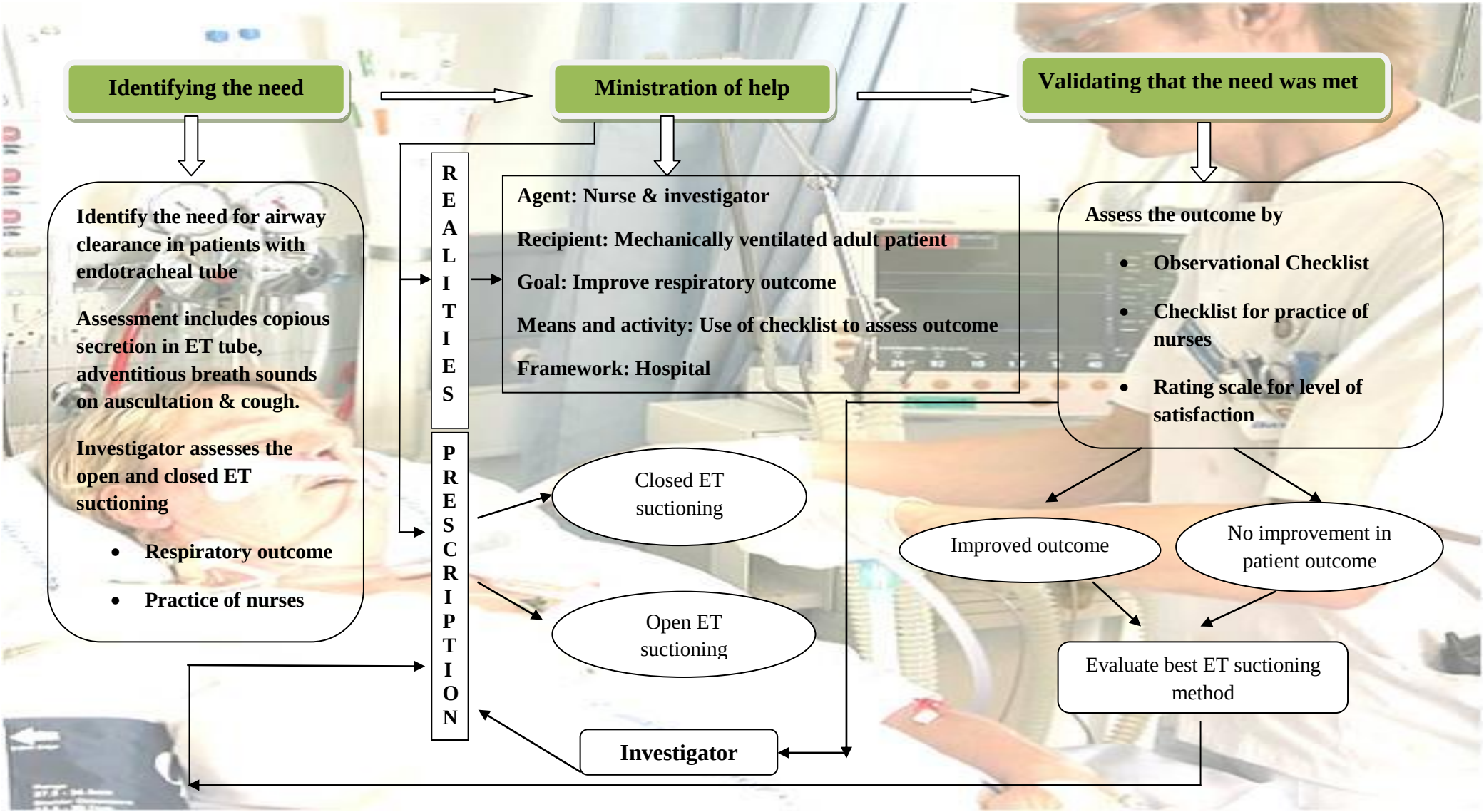

Fig. 1 Conceptual Framework based on Wiedenbach's Helping Art Of Clinical Nursing Theory (1964).

Projected outcome

The study will help to provide evidence based guidelines for the use of proper endotracheal suctioning systems and increase the knowledge and practice of nurses regarding the closed and open endotracheal suctioning systems upon the respiratory outcome and decrease complications of patients as well as increase their level of satisfaction among nurse in provision of nursing care.

Summary

This chapter has dealt with the background, need for the study, and statement of the problem, objectives, operational definitions, assumptions, null hypotheses, delimitations and conceptual framework.

Organization of the Report

Further aspects of the study are presented in the following five chapters.

CHAPTER – II : Review of literature

CHAPTER – III : Research methodology includes research approach, research design, setting, population, sample and sampling techniques, tool description, content validity and reliability of tools, pilot study, data collection procedure and plan for data analysis.

CHAPTER – IV : Analysis and interpretation of data

CHAPTER – V : Discussion

CHAPTER – VI : Summary, conclusion, implications and recommendations.

CHAPTER -II

REVIEW OF LITERATURE

A literature review is an organized written presentation of what has been published on a topic by scholars (Burns & Groove, 2004).

The task of reviewing literature involves the identification, selection, critical analysis and reporting of existing information on the topics of interest. A review acquaints the researcher with what has been done in the field and it minimizes possibilities of unintentional duplications. It justifies the need for replication provides the basis of future investigations and help to relate the findings of one study to another.

This chapter deals with a review of published and unpublished research studies and from related material for the present study. The review helped the investigator to develop an insight into the problem area. This helped the investigator in building the foundations of the study.

The review of literature for this study is presented under the following headings.

1. Literature related to airway management
2. Literature related to endotracheal suctioning
3. Literature related to outcome of closed and open endotracheal suctioning.

Literature Related to Airway Management:

A comparative study was conducted by Larsen, Guyette and Suyama (2010) to assess three airway management techniques in a simulated tactical setting. Thirty-one subjects completed the study, of whom 12 (39%) were medical flight crew members and

19 (61%) were EM residents. The mean number of attempts to intubate and ventilate the manikin was 1.03 for direct laryngoscopy, 1.26 for the King LT, and 1.67 for digital endotracheal intubation. Mean time to ventilation was 59.7 seconds for the King LT, 63.3 seconds for laryngoscopy, and 125.4 seconds for digital intubation. The use of the King LT provided less exposure than other techniques.

In university of Washington a study was conducted by Treggiari and Deem (2010) to examine whether new endotracheal tubes designed to prevent ventilator associated pneumonia make any difference. Modification of the ETT to reduce micro aspiration and/or biofilm formation may also play an important role in VAP prevention. However, despite numerous studies of various such interventions, there is insufficient evidence upon which to base strong recommendations, and important safety concerns remain regarding the use of some devices. Most importantly, cost-effectiveness data are lacking for modified ETTs designed to prevent VAP.

A comparative study of airway management with the intubating laryngeal mask, laryngeal tube and Cobra PLA was done by Kurola et al. (2006) among paramedical students in anaesthetized patients. They compared the success of insertion, oxygenation and ventilation of three methods. Twenty-four of the 32 students (75%) successfully inserted ILMA at the first attempt, compared with 14 of 32 (44%) for LT and seven of 32 (22%) for COB ($P<0.001$, ILMA vs. COB). One student failed to insert ILMA after all three attempts, compared with seven of 32 (21%) using LT and seven of 32 (21%) using COB (P=not significant). Oxygenation and ventilation parameters did not differ between the groups after successful insertion.

Among 1665 nurses and respiratory therapist at 27 sites Sole et al.(2003) conducted a descriptive, comparative, multisite survey of suctioning techniques and airway management practices. Most sites had policies for management of endotracheal tube cuffs (93%), hyperoxygenation (89%) and use of gloves (70%) with closed-system suctioning, and instillation of isotonic sodium chloride solution for thick secretions (74%). Only 48% of policies addressed oral care and 37% addressed oral suctioning. Nurses did more oral suctioning and oral care than respiratory therapists did, and respiratory therapists instilled sodium chloride solution more and rinsed the suctioning device more often than nurses did.

The effectiveness of airway management by using intubating laryngeal mask airway (ILMA) was assessed by Frappier et.al (2003) in 118 morbidly obese patients. The rate of successful tracheal intubation with ILMA was 96.3%. The time required for insertion of the ILMA was slightly longer in patients with high-grade laryngeal views. No adverse effect related to the technique was reported. Results of this study suggest that using the ILMA provides an additional technique for airway management.

In the University of Hospital Groningen a randomized prospective clinical trial was done by Leur et al. (2003). No differences were found between the routine endotracheal suctioning group and the minimally invasive airway suctioning group in duration of intubation [median (range) 4 (1-75) versus 5 (1-101) days], ICU-stay [median (range) 8 (1-133) versus 7 (1-221) days], ICU mortality (15% versus 17%), and incidence of pulmonary infections (14% versus 13%). There was decreased saturation: 2.7% versus 2.0% (P=0.010); increased systolic blood pressure 24.5% versus 16.8%

(P<0.001); increased pulse pressure rate 1.4% versus 0.9% (P=0.007); blood in mucus 3.3% versus 0.9% (P<0.001).

A retrospective study of 90 very-low-birth weight infants who were mechanically ventilated for longer than 7 days and comparison was done between two endotracheal suctioning frequencies. Suctioning per patient per ventilator day were 6 for the group suctioned every 4 hours and 4 for the group suctioned every 8 hours ($p < 0.01$). Cordero et al. (2001) suggested that a low-frequency suctioning regimen (every 8 hours plus as needed) can be implemented.

A randomized trial was done by Cook et.al.(1998) to review the influence of airway management on VAP in critically ill patients. The frequency of ventilator circuit changes and the type of endotracheal suction system do not appear to influence VAP rates (3 trials, none with significant difference; range of relative risks [RRs], 0.84-0.91). However, lower VAP rates may be associated with avoidance of heated humidifiers and use of heat and moisture exchangers (5 trials, only 1 showing a significant difference; range of RRs, 0.34-0.86).

An observational study of airway management in the emergency department(ED) was done by Sakles et al. (1997) to describe the method, success rates and immediate complication among 60,000 patients. A total of 610 patients required airway control in the ED; 569 (93%) were intubated. Overall, 49 patients (8.0%; 95% confidence interval [CI], 6% to 11%) experienced a total of 57 immediate complications (9.3%; 95% CI, 7% to 12%). Three patients sustained a cardiac arrest after intubation;

two of these patients had agonal rhythms before intubation, and one probably had a succinylcholine-induced hyperkalemic cardiac arrest.

Literature Related to Endotracheal Suctioning:

A standard practice guideline was developed for open and closed system suctioning by Ozden and Gorgulu (2012). The study determined the knowledge and practice of nurses before and after training. There was a significant difference between the mean scores of the answers ('true', 'wrong' and 'I do not know') for the use of open and closed system suctioning before and after training. The compliance of the nurses, their knowledge levels on the subject were increased after training, while the implementation of standards was satisfactory.

A comprehensive review done in Cochrane database to assess the effect of endotracheal suctioning without disconnection in intubated ventilated neonates by Taylor et al. (2011). Suction without disconnection resulted in a reduction in episodes of hypoxia and bradycardia. It also resulted in small percentage change in heart rate by 10%. The study suggested that suctioning without disconnection from the ventilator improves the short term outcomes; however the evidence is not strong enough to recommend this practice as the only method.

American association for respiratory care did an electronic search for articles published between 1990 and 2009 using MEDLINE, CINAHL, and Cochrane Library databases. The update of this clinical practice guideline is the result of reviewing a total of 114 clinical trials, 62 reviews and 6 meta-analyses on endotracheal suctioning. They suggested the following , performing suctioning without disconnection the patient from

the ventilator, use of closed suction is suggested for adults with high FiO2, or PEEP and duration of the suctioning event be limited to less than 15 seconds.

A systemic review of randomized controlled trails provided policies for endotracheal suctioning of patients receiving mechanical ventilation in terms of prevention of VAP. Snoeren et al. (2007) recommended that there be no preferential use of either open or closed endotracheal suction system to reduce the rate of VAP, but it elucidates that the quality of evidence is low. In closed suction system they recommended changing the inline suction catheters every 48 hours.

Bernay and Denehy (2006) did a double cross over study to compare the effect of manual and ventilator hyperinflation on static lung compliance and sputum production in intubated and ventilated intensive care patients. Twenty patients were studied. The first sequence involved manual hyperinflation followed two hours later by ventilator hyperinflation and the order was reversed on the second day. In the second sequence, ventilator hyperinflation preceded manual hyperinflation. There was no significant difference in sputum wet weight production between either techniques or on either day of treatment. Static pulmonary compliance improved with both hyperinflation techniques ($p < 0.05$).

Marrow, Flutter and Argent (2006) conducted a prospective observational clinical study to assess the effect of endotracheal suction on lung dynamics in mechanically ventilated pediatric patients. Lung mechanics were recorded for five minutes before and five minutes after suctioning procedure in 78 patients. There was a significant overall decrease in dynamic compliance ($p < 0.001$) and mechanical expired

tidal volume (p = 0.03) following suctioning with no change in the percentage endotracheal tube leak (p = 0.41). There was no significant change in expiratory or inspiratory airway resistance following suctioning ($p > 0.05$). There is no evidence that suctioning reduces airway resistance.

An experimental study was conducted by Lindgren et al. (2004) to compare the effectiveness of closed (CSS) versus open (OSS) suctioning systems and the side effects on gas exchange and hemodynamics during pressure controlled ventilation (PCV) or continuous positive airway pressure (CPAP). Suctioning with 12 and 14 Fr catheters was significantly more efficient with OSS. OSS and CSS at CPAP 0 cm H_2O resulted in a marked decrease in SpO_2.

A metaanalysis was conducted by Oh and Seo (2003) to assess the effects of various interventions in preventing endotracheal suction- induced hypoxemia by examining 30 research reports in terms of the application time of oxygenation, insufflation and preoxygenation. Hyper oxygenation and hyperinflation were most frequently induced by FiO2 of 1 and a 150% tidal volume of three to six breaths, respectively. Suctioning was commonly sustained for <15 seconds using pressures of -80 to -120 mmHg and with size 14 French catheters. Insufflation was less effective than the other methods examined in the present study.

Akgul and Akyolcu (2002) conducted an experimental study to assess the effect of normal saline on endotracheal suctioning among 20 mechanically ventilated ICU patients. Each patient was monitored for 5 minutes following suctioning with or without saline solution and findings of heart rate, SpO_2, and blood gas measurements were

recorded. No significant difference was found between pH levels recorded prior to and 5 minutes after suctioning without saline solution; however, the increase in pH following suctioning with saline solution was significant. Patients undergoing suctioning with saline solution exhibited significantly increased heart rates in the fifth minutes.

A survey developed by Paul-Allen and Ostrow (2000) among 241 critical care nurses to assess the nursing practices with closed system suctioning. The survey concluded that closed-system suctioning is common in critical care setting, and current nursing practices of closed system suctioning (CSS) vary. Use of hyperoxygenation is more common than use of hyperinflation with (CSS). Nurses had knowledge deficits about the proper performance of hyperoxygenation and hyperinflation.

A study was conducted by Mc Carren and Chow (1998) for the description of manual hyperinflation in intubated patients with atelectasis. Two physiotherapists manually hyperinflated 12 patients for 5 min each with a Laerdal (1.6L) resuscitation circuit. The tidal volume, inflation flow rate, airway pressure and manual hyperinflation rate were measured. During manual hyperinflation, they applied a mean tidal volume of 973.8 ml, airway pressure of 32.7 cm H_2O and inflation flow rate of 713.8 ml/sec, with a manual hyperinflation rate of 9.1 b/min. The measurements obtained were within the ranges that might be capable of reversing atelectasis and minimizing the effects of suctioning.

A quasi experimental study was conducted by Grap et.al. (1996) to compare the manual and mechanical delivery of hyperoxygenation before and after endotracheal

suctioning in 29 ventilated patients. Arterial pressure, capillary oxygen saturation, heart rate, and cardiac rhythm were monitored for 1 minute prior to the intervention to obtain a baseline, continuously throughout the procedure, and for 3 minutes afterward. Significant increases were observed in mean arterial pressure during and after suctioning, with both delivery methods, with no difference between methods.

Literature Related to Outcome of Closed and Open Endotracheal Suctioning:

A prospective observational study was conducted by Jongerden et al. (2012) assessed the changes in heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO_2) after open (OSS) and closed (CSS) endotracheal suctioning. In total, 197 complete ES procedures (103 OSS and 94 CSS) were monitored. Changes in HR and MAP were comparable after using CSS and OSS, whereas in SpO_2, slightly better values were monitored 3 and 5 minutes after OSS, these differences being rather small (0.3%-0.7%) and clinically not relevant.

Giakoumidaki et al. (2011) conducted a quasi experimental study to investigate the effects of two suctioning techniques on oxygen saturation and the amount of drained secretions. In examining each suctioning technique separately, the use of normal saline instillation was associated with a decrease in SaO_2 levels 1 minute ($p<0.001$) and 15 minutes ($p=0.002$) after this procedure. In addition, suctioning without normal saline instillation was associated with a decrease in SaO_2 1 minute ($p<0.001$) after the suction. Comparing the two techniques, none is superior to the other resulting from the statistically insignificant comparative differences in SaO_2 values.

A Randomized, comparative analysis between two tracheal suction systems in neonates by Paula and Ceccon (2010). They compared the variations in oxygen saturation throughout the suctioning procedure (before, during, and after) using two endotracheal suction systems: open suction system (OSS) vs. closed suction system (CSS). No statistically significant differences were observed when OSS and CSS were compared in both groups. There was a statistically significant improvement in post-procedure oxygen saturation in both groups.

A critical analysis for the use of endotracheal suctioning system was made by Harada (2010). The analysis suggested that there is no difference between open and closed suctioning system in terms of mortality, morbidity, or the cost benefit ratio. A few studies suggested that closed suctioning might reduce the loss of lung volume and oxygen saturation. The studies reviewed in this article suggest that the evidence on the efficacy and effectiveness of closed suctioning systems is inconclusive.

A metaanalysis of randomized controlled trials was done by Siempos, Vardakas and Falagas (2008) to assess the evidence of closed tracheal suction system (TSS) in prevention of ventilator associated pneumonia. There was no difference in the incidence of VAP between patients managed with closed and open TSS [odds ratio (OR) = 0.96.95% confidence intervals (CI) 0.72-1.28]. Suctioning with closed systems was associated with longer mechanically ventilated duration (weighted mean differences: 0.65 days, 95% CI 0.28-1.03) and higher colonization of the respiratory tract (OR=2.88, 95% CI 1.50-5.52) than open TSS.

In Cochrane database system a systemic review included 16 trials (1684 patients) was done by Subirana et al. (2007) to compare the closed versus open tracheal suction systems for mechanically ventilated patients. The two tracheal suction systems showed no differences in risk of VAP (11 trials; RR 0.88; 95% CI 0.70 to 1.12), mortality (five trials; RR 1.02; 95% CI 0.84 to 1.23) or length of stay in intensive care units (two trials; WMD 0.44; 95% CI -0.92 to 1.80). The closed tracheal suction system produced higher bacterial colonization rates (five trials; RR 1.49; 95% CI 1.09 to 2.03.)

Gaudet, Branconnier and Hess (2006) conducted a study to evaluate the simulated tracheal pressure with open and closed suction during high frequency oscillatory ventilation (HFOV). There was a significant change in mean tracheal pressure (29 ± 9% decrease; $P < 0.001$) and amplitude (64 ± 5% decrease; $P < 0.001$) when closed suction was applied. The pressure at the simulated tracheal level was always positive with closed suction. With open suction, the pressure at the simulated tracheal level dropped quickly to atmospheric.

A study included two group students 236 with closed tracheal suction system (CTSS) and 221 with open tracheal suction system (OTSS) to evaluate the cost and incidence of VAP. Lorente et al. (2006) conclude that there was no significant difference between both percentage of patients who developed VAP (13.9 vs 14.1%) or the number of ventilator-associated pneumonia per 1000 days of mechanical ventilation (14.1 vs 14.6). The cost was higher with CTSS than with OTSS (7.2+/-4.7 vs 1.9+/-0.6 Euros; $p<0.001$.

Lasocki et al. (2006) compared the gas exchange and efficiency between open (OES) and closed- circuit (CES) endotracheal suctioning at two levels of negative

pressure. OES induced a significant 18% decrease in arterial oxygen tension (range +13 to -17%) and an 8% increase in arterial carbon dioxide tension (range, -2 to +16%) that persisted 15 min after the end of the procedure. CES followed by a recruitment maneuver prevents hypoxemia resulting from OES but decrease secretion removal. Increasing suctioning pressure enhances efficiency without impairing gas exchange.

Nine trials with 648 patients in the open suctioning group and 644 in the closed suctioning group were assessed to find the impact of suctioning system (open vs closed) on the incidence of VAP. VAP occurred in 128 (20%) of the open suctioning group and in 120 (19%) in the closed suctioning group (relative risk 0.95). Vonberg et al. (2006) concluded that the choice of suctioning system should therefore be based on handling, cost, and individual patient's disease.

El Marsy et al. (2005) evaluated the impact of closed endotracheal suctioning systems on mechanical ventilator performance. During suctioning, end-expiratory pressure markedly decreased in all modes, and peak flow increased in all modes except volume-assist/control ($p < 0.001$). Respiratory rate increased during suctioning in pressure- and volume-assist/control ($p < 0.001$) but not during pressure support or continuous positive airway pressure. Gas delivery was most altered during volume-assist/control with the smaller tidal volume ($p < 0.05$) and least altered during pressure-assist/control with the larger tidal volume.

A cross over study was conducted by Tan et al. (2005) compare the severity, incidence of desaturation and bradycardia between closed versus partially ventilated endotracheal suction in neonates. The closed tracheal suction system reported a significantly smaller degree of oxygen saturation fall ($P<0.005$) and significantly fewer

incidences of desaturation. There was also a significantly smaller degree of heart rate reduction although episodes of bradycardia were not significantly different between the two methods.

Fernandez et al. (2004) conducted a prospective crossover study to compare changes in lung volume, oxygenation, airway pressure, and hemodynamic effects. The reductions in lung volume during suctioning were similar with the quasi-closed (386+/-124 ml) and closed system (497+/-338 ml), but significantly higher with the open system (1281+/-656 ml, P=0.022). There is no significant hemodynamic adverse effects, and no significant SpO_2 reductions with all the studied suctioning techniques.

A prospective in vitro study was conducted by Morrow, Futter and Argent (2004) to highlight the principles to practice. There was a linear relationship ($r=0.8$, $p<0.05$) between peak pressure change and the ratio of external catheter area to area difference. Significantly greater peak pressure change was measured when using a short versus long suction catheter ($p<0.001$) and when applying suction for longer duration ($p<0.001$) and with higher vacuum pressures ($p<0.05$). The amount of mucus suctioned in a given time was related to catheter size, suction pressure and mucus density.

Ventilator associated pneumonia development was compared among 41 closed and 37 open endotracheal suction systems. Thirteen patients in the open suction group and 16 patients in the closed suction group became colonized (P=0.14). The colonization rates by Acinetobacter spp. and Pseudomonas aeruginosa were more frequent in the closed suction group than in the open suction group (P<0.01 and P=0.04,

respectively). Closed suction leads to more colonization rates as concluded by Topeli (2004).

A clinical trial was done to compare the loss of lung volume with open versus in-line catheter endotracheal suctioning. Total lung volume loss was greater with open catheter suction compared with in-line catheter suction systems ($p = .008$). Patients suctioned with open catheter suction desaturated to a greater extent than patients suctioned with in-line catheter suction ($p = .026$). Choong et al. (2003) suggested that in-line catheter is preferable in patients with significant lung disease and who require high positive end-expiratory pressures.

A prospective randomized study was done to evaluate the microbial colonization due to prolonged application of closed in-line suction (CISC) in 23 mechanically ventilated patients. The study done by Freytag et al (2003) revealed that application for 72 h significantly enhanced the microbial growth on the CISC tips and on the adjacent catheter segment. Usage for 3 days led to a significant increase in colonization in the lower respiratory tract.

Maggiore et al. (2002) conducted a study to assess the effectiveness of closed versus open suctioning techniques. The closed-suction system has some advantages compared to the conventional, open-suction technique. It can be helpful in limiting environmental, personnel and patient contamination and in preventing the loss of lung volume and the alveolar derecruitment associated with standard suctioning in the severely hypoxemic patients. However, the impact of the closed system on VAP and cost-effectiveness remain to be assessed.

Cereda et al. (2001) conducted a study to assess the effectiveness of closed system endotracheal suctioning maintains lung volume during volume-controlled mechanical ventilation. They compared the compared changes in lung volume (VTrt), oxygenation (SpO_2), airway pressure and hemodynamics. Loss in lung volume and oxygenation during open system (OS) was significantly higher than during closed system (CS). During CS ventilation was not interrupted and respiratory rate increased while VTrt decreased.

A prospective randomized cross-over study was done by Lee et al. (2001) to evaluate the effect of closed system (CS) versus open system (OS) endotracheal suctioning on heart rate (HR), mean arterial pressure (MAP), respiratory rate (RR), oxygen saturation (SpO_2) and electrocardiogram (ECG) rhythm of patients on mechanical ventilation. Compared to CS, OS suctioning was found to result in higher HR (P < or = 0.05) and (P < or = 0.05); higher MAP at (P < or = 0.05); lower SpO_2 (P < or = 0.01) and (P < or = 0.01). There was no significant difference in RR between the two suctioning systems. OS suctioning was also noted to result in a significantly higher incidence of arrhythmia (P < = or 0.05).

Summary

This chapter has dealt with review of literature related to the problem stated. It has helped the researcher to understand the impact of the problem under study. It has also enabled the investigator to design the study, develop the tool, plan the data collection procedure and to analyze the data.

CHAPTER-III

RESEARCH METHODOLOGY

The methodology of the research study is defined as the way the data are gathered in order to answer the questions to analyze the research problem. It enables the researcher to project a blue print for the research undertaken. The research methodology involves a systematic procedure by which the researcher had a start from the initial identification of the problem to its final conclusion.

This chapter deals with a brief description of different steps undertaken by the researcher for the study. It involves research approach, research design, setting, population, sample and sampling technique, sampling criteria, selection and development of the instruments, validity and reliability of the instruments, pilot study, data collection procedure and plan for data analysis. The present study is conducted to assess the effectiveness of closed and open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients.

Research Approach

Research approach is the most significant part of any research. The appropriate choice of the research approach depends on the purpose of the research study which is undertaken.

According to Polit and Beck, (2008), an evaluation research is most often used when researchers are trying to determine the effectiveness of a rather complex program, rather than when they are evaluating a specific entity. Evaluation research tends to evaluate a program practice or intervention that is embedded in a organizational context.

An evaluative research design is chosen for this study to compare the effectiveness of closed endotracheal suctioning and open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients.

Research Design

According to Polit and Beck (2008), a research design is the overall plan for addressing a research question, including specifications for enhancing the study's integrity.

A pretest posttest design was adopted for conducting this study.

O_1 X_1 O_2 O_3 O_4

O_1 X_2 O_2 O_3 O_4

O_1 - Preobservation of respiratory parameters before suctioning

X_1 - Closed endotracheal suctioning

X_2 - Open endotracheal suctioning

O_2 - Assessment of respiratory outcome during suctioning

O_3 - Assessment of respiratory outcome after 5 min of suctioning

O_4 - Assessment of respiratory outcome after 15 min of suctioning

The research design is represented diagrammatically as follows:

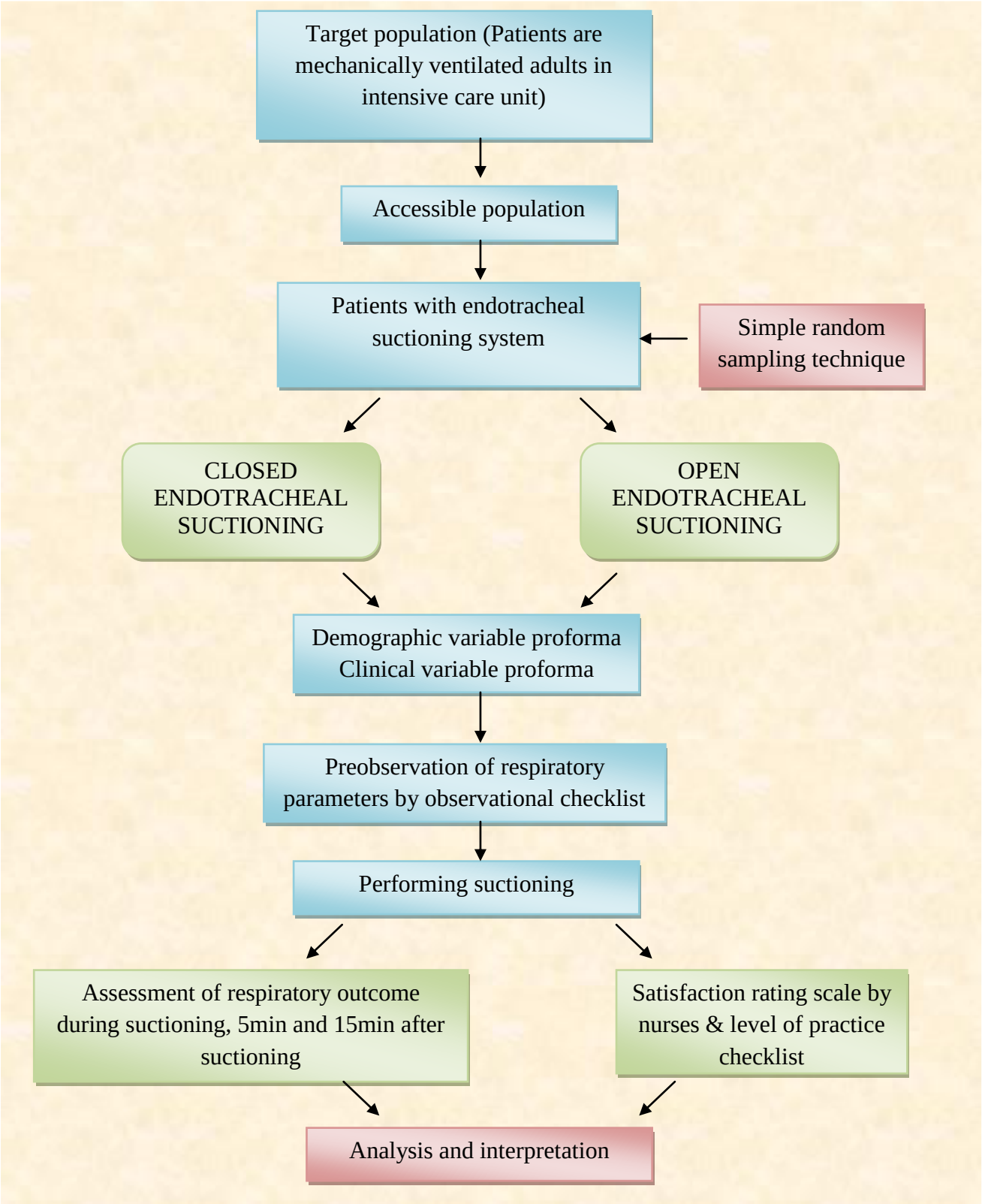

Fig.2 Schematic Representation of the Research Design.

Variables

Independent variable

The variable that is believed to cause or influence the dependent variable is the independent variable (Polit and Beck, 2008).

In this study, the closed and open endotracheal suctioning was considered as independent variables.

Dependent variable

The variable hypothesized to depend on or be caused by another variable is the dependent variable (Polit and Beck, 2008).

In this study, the respiratory outcome was considered as the dependent variable.

Attribute variable

Variables that describe the study sample characteristics are termed as attribute variables (Polit and Beck, 2008).

In this study, the attribute variables were demographic variable proforma and clinical variable proforma of mechanically ventilated adult patients.

Research Setting

The physical location and condition in which a data collection takes place in a study.(Polit and Beck, 2008). The present study was conducted at Apollo Main Hospital and Apollo Speciality Hospital in Chennai.

Population

The **target population** is the group of population that the researcher aims to study and to whom the study finding will be generalized. In this study, target population will be mechanically ventilated adult patients in Intensive Care Unit.

The **accessible population** is the list of population that the researcher finds in the study area. The accessible population in this study was mechanically ventilated adult patients in Intensive Care Unit at Apollo Main Hospital and Apollo Speciality Hospital, Chennai.

Sample

The sample is the subset of population, selected to participate in a study. (Polit and Beck, 2008). A sample consists of mechanically ventilated patient in Intensive Care Unit at Apollo Main Hospital and Apollo Speciality Hospital, Chennai who satisfied the inclusion criteria.

Sample size

Sample of this study were 100 mechanically ventilated patients, 50 in the closed endotracheal suctioning group and 50 in the open endotracheal suctioning group who satisfied the inclusion criteria.

Sampling Technique

Sampling is the process of selecting a portion of the population to represent the entire population (Polit and Beck, 2008). Simple random sampling technique was used in this study.

Sampling Criteria

Inclusion criteria

The study includes

- Patient admitted in intensive care unit.
- Patient on mechanical ventilator support.
- Stable and recovered from high risk condition.
- Age group between 20 to 60 years of age.

Exclusion criteria

The study excludes

- Patients who are critically ill.
- Patient on noninvasive ventilator support.
- Patient undergone cardiothoracic surgery.

Selection and Development of Study Instruments

The data collection instruments were developed through an extensive review of literature and in consultation with the opinion of experts and opinion of faculty members. The instruments used in this study are demographic variable proforma, clinical variable proforma, observational checklist for respiratory parameters, rating scale on level of satisfaction of nurses and practice observational checklist for nurses.

Demographic variable proforma of mechanically ventilated adult patients

This proforma is used to measure the demographic variables of patients such as sample number, age, sex, occupational outcome, place of work, nature of work and history of alcoholism and smoking.

Clinical variable proforma of mechanically ventilated adult patients

This proforma is used to measure the clinical variable of patients such as mode of ventilation, body mass index, past medical and surgical history, ventilator days, alertness of patient, use of nebulization, presence of humidifier and other health related information.

Observational checklist

For respiratory parameters

This observational checklist comprises of patients outcome including oxygenation, respiratory rate, normal breath sounds, use of accessory muscles, FiO_2, PIP, tidal volume, PaCO2, PaO_2, blood pressure, heart rate, number of days on ventilator, temperature, secretion characteristics and ET culture.

Scoring key

1-25%	-	Highly negative outcome
25.1-50%	-	Negative outcome
50.1-75%	-	Positive outcome
75.1-100%	-	Highly positive outcome

Rating scale on level of satisfaction

The rating scale consist of 3 responses for closed endotracheal suctioning and open endotracheal suctioning, the nurse can choose acceptable option for it based on their level of satisfaction.

Score Interpretation

<50%	-	Dissatisfied
50-75%	-	Satisfied
>75%	-	Highly satisfied

Practice observational checklist

The practice observational checklist consist of 3 responses for closed and open endotracheal suctioning, the researcher collects information by observing the nurses while performing the procedure.

Score Interpretation

<50%	-	Poor performance
50-75%	-	Average performance
>75%	-	Good performance

Psychometric Properties of the Instruments

Validity

Content validity is the degree to which an instrument measures what it is supposed to measure. Content validity is the sampling adequacy of the content being measured. (Polit and Beck, 2008).

The content validity of the tool was obtained by getting opinion from experts in the field of Medicine and Nursing. The validation has suggested some specific modifications in the objectives and rating scale. The modifications and suggestions of experts were incorporated in the final preparation of the tool.

Reliability

Reliability is the degree of consistency with which an instrument measures the attribute it intended to measure (Polit & Beck, 2008). The reliability of the tools was determined by using split half method and inter rater technique. Karl Pearson's 'r' was computed for finding out the reliability.

Practice observational check list for nurses – Inter rater technique (r = 0.76)

Rating scale for nurses satisfaction – Split half method (r = 0.86)

Pilot Study

According to Polit and Beck. (2009), a pilot study is a miniature or some part of the actual study, in which the instruments are administered to the subjects drawn from the population. It is a small scale version or trial run, done in preparation for the major study. The purpose is to find out the feasibility and practicability of the study design.

The pilot study was conducted in Apollo Speciality Hospital at Chennai from 11.06.2012 to 23.06.12. Ten patients with closed suction system and ten patients with open suction system were selected as study participants. Preobservation of the respiratory parameters was done by using observation check list. Consecutively three observations were done immediately after suction, 5min and at 15min. The observation was done for three days for each patient.

Protection of Human Rights

- The study was conducted after obtaining clearance from Ethical committee, Apollo Hospitals, Chennai.
- Consent was obtained from all the participants/bystander before the data collection.
- Confidentiality was maintained throughout the study

Data Collection Procedure

Data collection is the precise, systematic gathering of information relevant to the research purpose. The researcher presented the proposal to the Ethical committee Apollo Hospitals and got ethical clearance to precede the study. The investigator collected the data from Apollo Speciality Hospital and Apollo Main Hospitals after obtaining proper administrative permission from concerned authorities. The observation time schedule was from 7a.m-12 noon and 12.30 p.m-5.30 p.m and the data collection period was from June 18th to July 23rdth 2011.

A group of 100 mechanically ventilated adults patients were selected by simple random sampling method and consent was obtained from the relatives. Among the 100 mechanically ventilated patients 50 patients belong to closed endotracheal suctioning and 50 patients belong to open endotracheal suctioning. The baseline data are collected through the demographic variable and clinical variable proforma.

Three consecutive observations were assessed for three days with data collection tool. The respiratory outcome was assessed by using observational check list. The respiratory outcome was observed at an interval of preobservation before suction, during suction, 5min and 15min after suction in both closed and open endotracheal suctioning. The observation was done for 3 consecutive days for each patient. Then the level of satisfaction of nurses was assessed using rating scale in both closed and open endotracheal suctioning. The level of practice of nurses was also assessed by using practice observational checklist in closed and open endotracheal suctioning.

Problems Faced during Data Collection

The problems faced during the data collection were,

- Lack of time for nurses to participate in the study.
- Few patients were not interested to provide information.
- Follow up is difficult.

Plan for Data Analysis

Data analysis is the systematic organization, synthesis of research data, and testing of null hypothesis by using obtained data (Polit & Beck, 2008).

Analysis and interpretation of the data were carried out by using descriptive and inferential statistics. Descriptive statistics like frequency distribution, percentage, mean standard deviation and inferential statistics like t-test and chi square test were used to analyze the data.

Summary

This chapter dealt with the selection of research approach, research design, setting, population, sample, sampling technique, sampling criteria, selection and development of study instruments, validity, reliability of the study, pilot study, data collection procedure, problem faced during data collection and plan for data analysis.

CHAPTER - IV

ANALYSIS AND INTERPRETATION

This chapter includes both descriptive and inferential statistics. Statistics is a field of study concerned with techniques or methods of collection of data, classification, summarizing, interpretation, drawing inferences, testing of hypothesis, making recommendation. (Mahajan 2004)

The data was collected from 100 mechanically ventilated patients in Apollo Main Hospital and Apollo Speciality Hospital, Chennai to determine the effectiveness of closed and open suction system on respiratory outcome. The data were analyzed according to the objectives and hypothesis of the study. Analysis of study was completed after all the data was transferred to the master coding sheet. The investigator used descriptive and inferential statistics for analysis**.**

Organization of findings

The findings of the study were organized and presented under the following headings

- Frequency and percentage distribution of demographic variables of mechanically ventilated adult patients with closed and open endotracheal suctioning.
- Frequency and percentage distribution of clinical variables of mechanically ventilated adult patients with closed and open endotracheal suctioning.
- Comparison of mean and standard deviation of respiratory outcome of mechanically ventilated adult patients with closed and open endotracheal suctioning.

- Comparison of paired‘t’ test of respiratory outcome of mechanically ventilated adult patients with closed and open endotracheal suctioning.
- Comparison of mean and standard deviation of respiratory outcome of each category of mechanically ventilated adult patients with closed and open endotracheal suctioning.
- Frequency and percentage distribution of respiratory outcome of mechanically ventilated adult patients with closed and open endotracheal suctioning.
- Frequency and percentage distribution of each category in level of satisfaction of nurses regarding respiratory outcome in closed and open endotracheal suctioning in mechanically ventilated adult patients.
- Frequency and percentage distribution of each category in practice of nurses while performing closed and open endotracheal suctioning among mechanically ventilated adult patients.
- Association between the selected demographic variables and respiratory outcome in closed and open endotracheal suctioning in mechanically ventilated adult patients.
- Association between the selected clinical variables and respiratory outcome in closed and open endotracheal suctioning in mechanically ventilated adult patients.

Table 1

Frequency and Percentage Distribution of Demographic Variables of Mechanically Ventilated Adults Patients with Closed and Open Endotracheal Suctioning.

DEMOGRAPHIC VARIABLES	Closed Endotracheal Suctioning n=50		Open Endotracheal Suctioning n=50	
	(n)	(p)	(n)	(p)
Age in years				
20-30years	5	10%	9	18%
31-40 years	10	20%	10	20%
41-50 years	9	18%	8	16%
51-60 years	26	52%	23	46%
Sex				
Male	32	64%	34	68%
Female	18	36%	16	32%
Place of work				
Indoor	33	66%	30	60%
Outdoor	17	34%	20	40%
Nature of work				
Sedentary	28	56%	29	58%
Moderate	14	28%	15	30%
Severe	8	16%	6	12%
History of alcoholism				
Yes	15	30%	10	20%
No	35	70%	40	80%

The data from the table 1 revealed that most of the patients in the closed and open endotracheal suctioning were between the age group of 51-60 (52%, 46%), male were (64%, 68%), employed (44%, 46%), indoor worker (66%, 60%) and sedentary workers (56%, 58%) respectively. Significant percentage of patient had history of alcoholism (30%, 20%) in closed and open endotracheal suctioning respectively.

Fig.3 infers that significant percentage of mechanically ventilated adult patients were employed (44%, 46%) in closed and open endotracheal suctioning respectively.

Fig.4 infers that majority of mechanically ventilated adult patients had no history of smoking (76%, 74%) in closed and open endotracheal suctioning respectively.

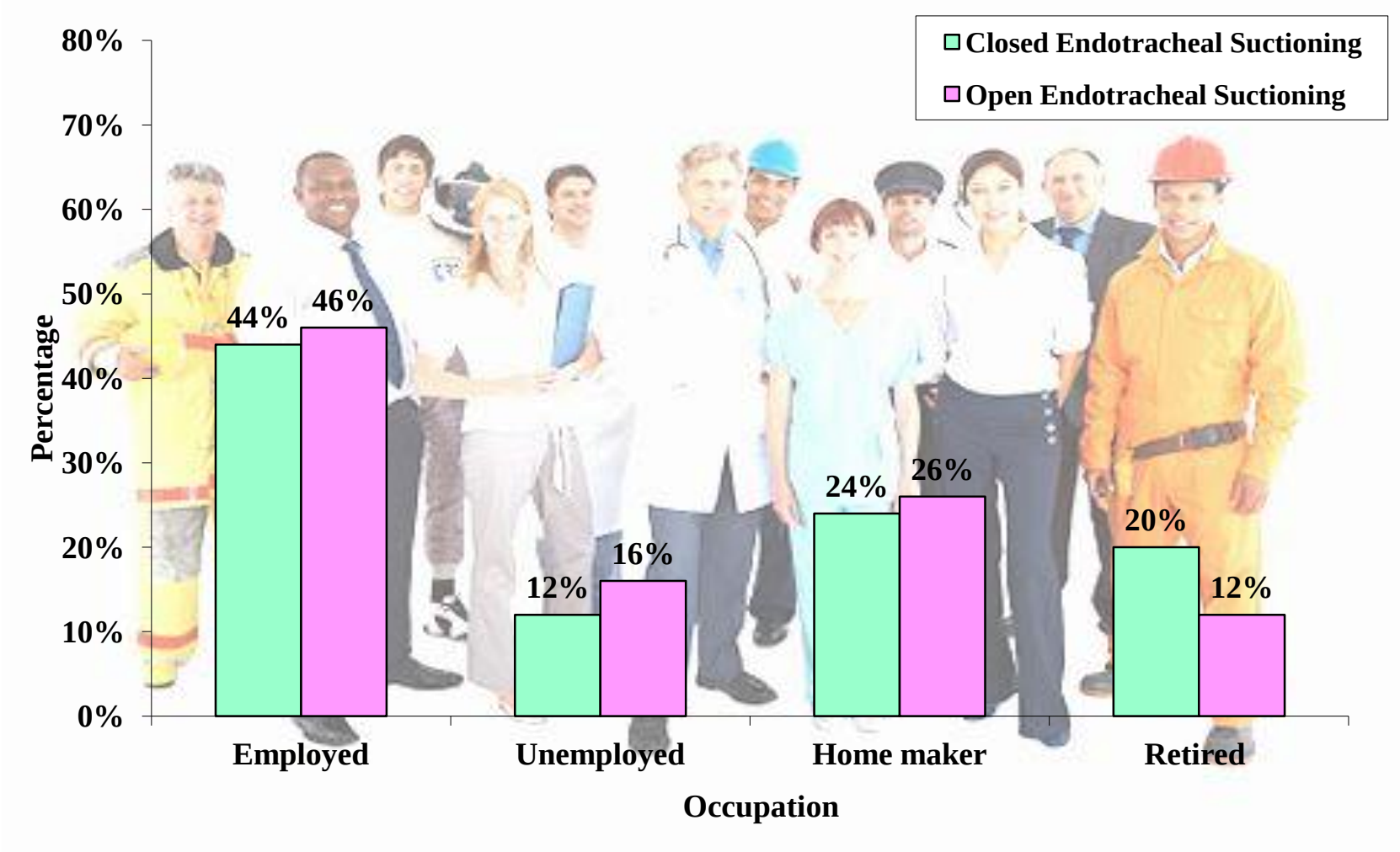

Fig. 3 Percentage Distribution of Occupation of Mechanically Ventilated Adult Patients

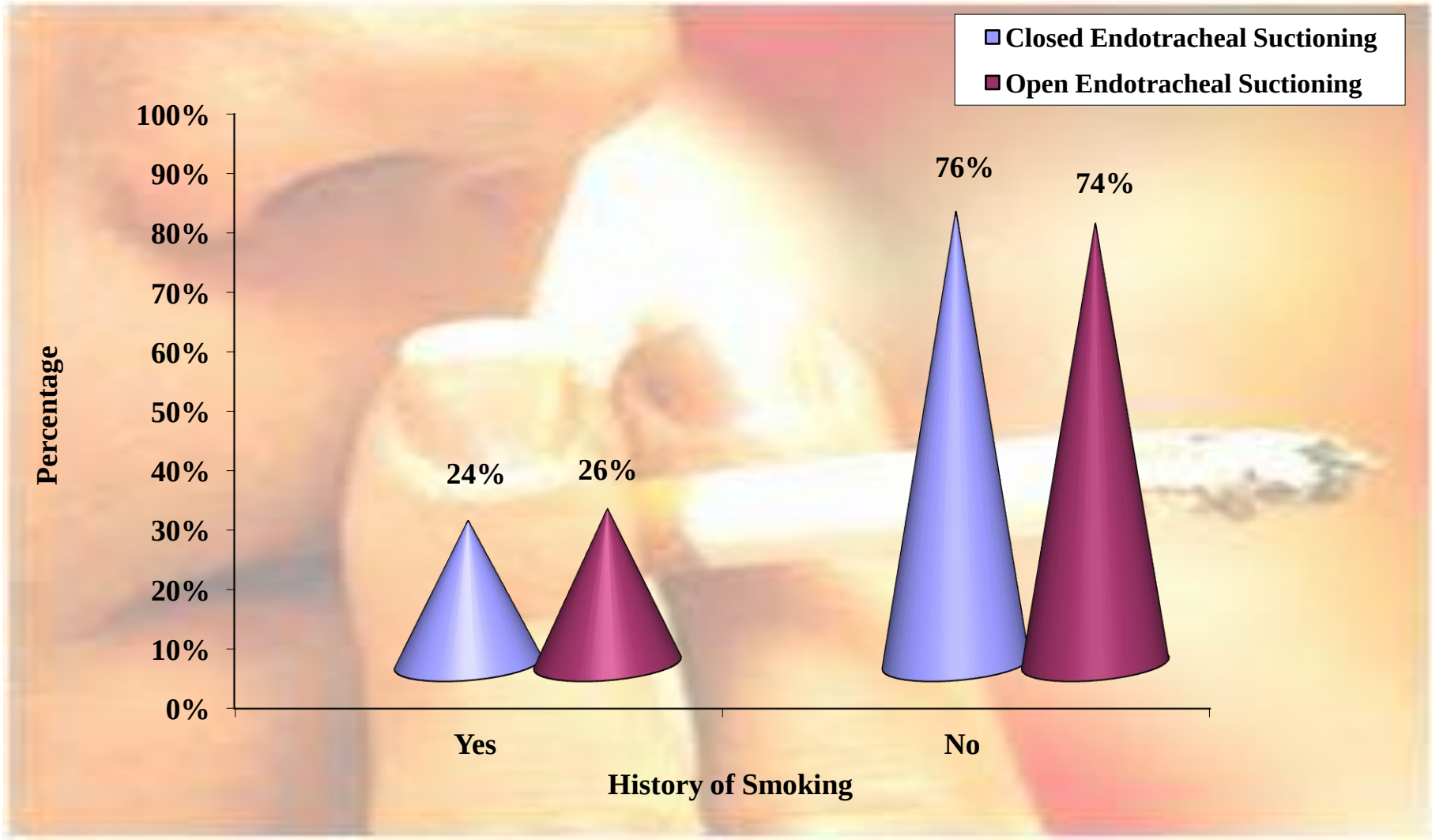

Fig. 4 Percentage Distribution of History of Smoking in Mechanically Ventilated Adult Patients

Table 2

Frequency and Percentage Distribution of Clinical Variables of Mechanically Ventilated Adults Patients with Closed and Open Endotracheal Suctioning

CLINICAL VARIABLES	Closed Endotracheal Suctioning n=50		Open Endotracheal Suctioning n=50	
	(n)	(p)	(n)	(p)
Reason for mechanical ventilation				
Respiratory failure	11	22%	5	10%
Disease condition that prevents normal breathing	12	24%	14	28%
Trauma / shock	14	28%	18	36%
Others	13	26%	13	26%
Body mass index				
Underweight	11	22%	7	14%
Normal weight	14	28%	16	32%
Over weight	21	42%	25	50%
Obesity	4	8%	2	4%
Alertness of patient				
Conscious	26	52%	21	42%
Sedated/ paralyzed	24	48%	29	58%
Vacuum pressure level during suctioning				
10-100mmhg	0	0%	0	0%
101-200mmhg	0	0%	0	0%
201-300mmhg	50	100%	50	100%
Chest physiotherapy				
Yes	22	44%	14	28%
No	28	56%	36	72%
Presence of humidifier				
Yes	20	40%	7	14%
No	30	60%	43	86%
Previous history of respiratory illness				
Yes	8	16%	3	6%
No	42	84%	47	94%

Presence of co-morbid illness				
Yes	27	52%	26	52%
No	23	46%	24	48%
Treatment of co-morbid illness				
Yes	27	54%	25	50%
No	23	46%	25	50%
History of trauma / accident				
Yes	6	12%	14	28%
No	44	88%	36	72%
History of surgeries in past				
Yes	14	28%	12	24%
No	36	72%	38	76%

The data presented in table 2 reveals that in closed endotracheal suctioning group significant number of patients reason for ventilation was trauma (28%), (42%) were overweight, (40%) had humidifier, (16%) of patients have history of previous respiratory illness, (12%) had history of trauma and (28%) had history of surgery (28%). Most of the patients in closed endotracheal suctioning were conscious (52%), (56%) received physiotherapy, (52%) had co-morbid illness and (54%) undergone treatment for co-morbid illness.

In open endotracheal suctioning group significant number of the patients reason for ventilation (36%) was trauma, (28%) of patients get physiotherapy, (14%) have humidifier, (6%) had history of previous respiratory illness, (28%) have history of trauma and (24%) have history of surgery. Most of the patients were overweight (50%), sedated/ paralyzed (58%), (52%) had co-morbid illness and (50%) undergone treatment for co-morbid illness in open endotracheal suctioning.

Fig.5 infers that most of the mechanically ventilated adult patients were diagnosed to have neurological disease (34%, 60%) in closed and open endotracheal suctioning respectively.

Fig.6 reveals that majority of the mechanically ventilated adult patients had 1 to 3 days of ventilation (64%, 80%) in closed and open endotracheal suctioning respectively.

Fig.7 reveals that most of the mechanically ventilated adult patients were on nebulization (64%, 40%) in closed and open endotracheal suctioning respectively.

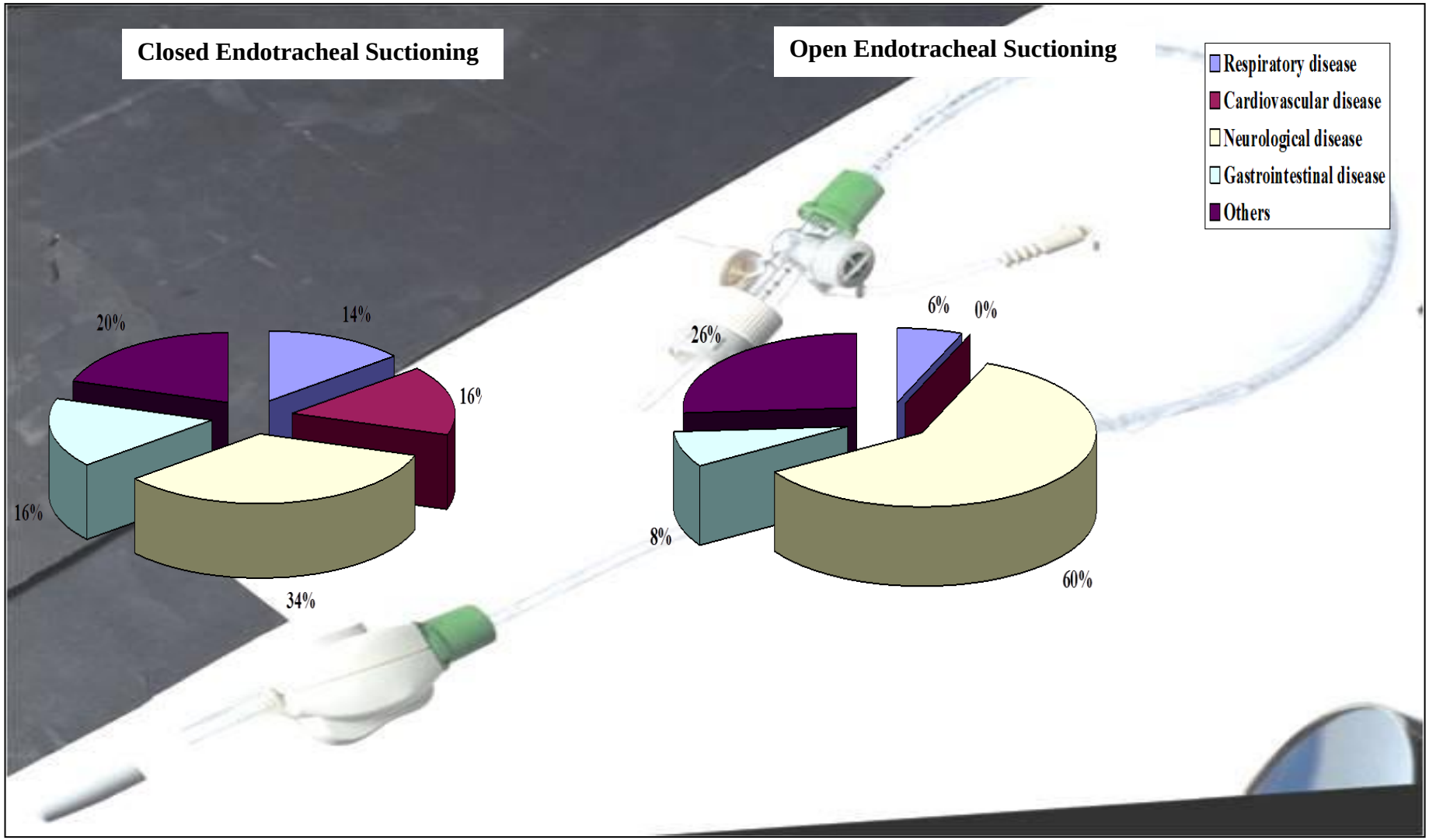

Fig. 5 Percentage Distribution of Diagnosis of Mechanically Ventilated Adult Patients

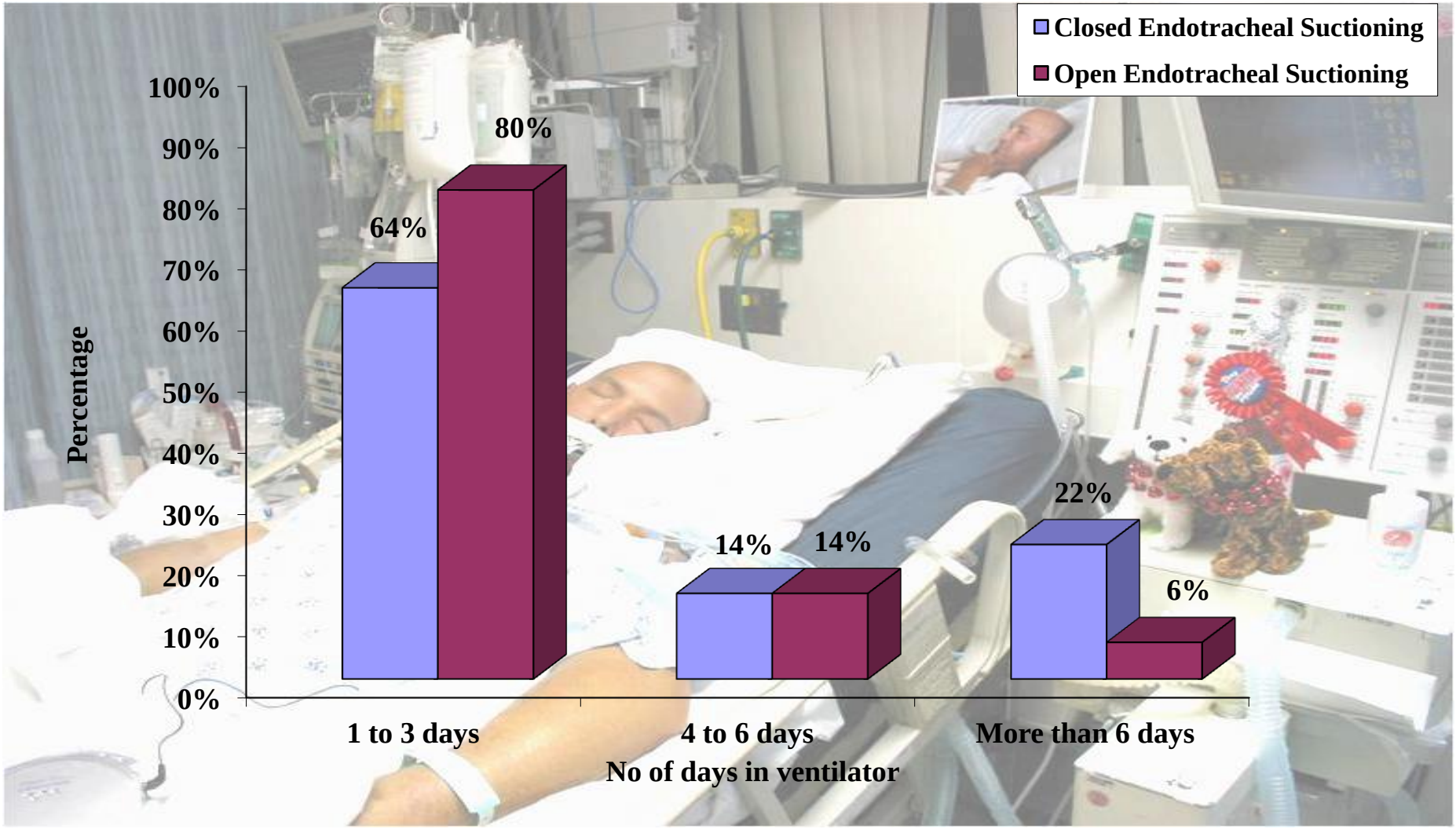

Fig. 6 Percentage Distribution of Number of Days in Ventilator in Mechanically Ventilated Adult Patients

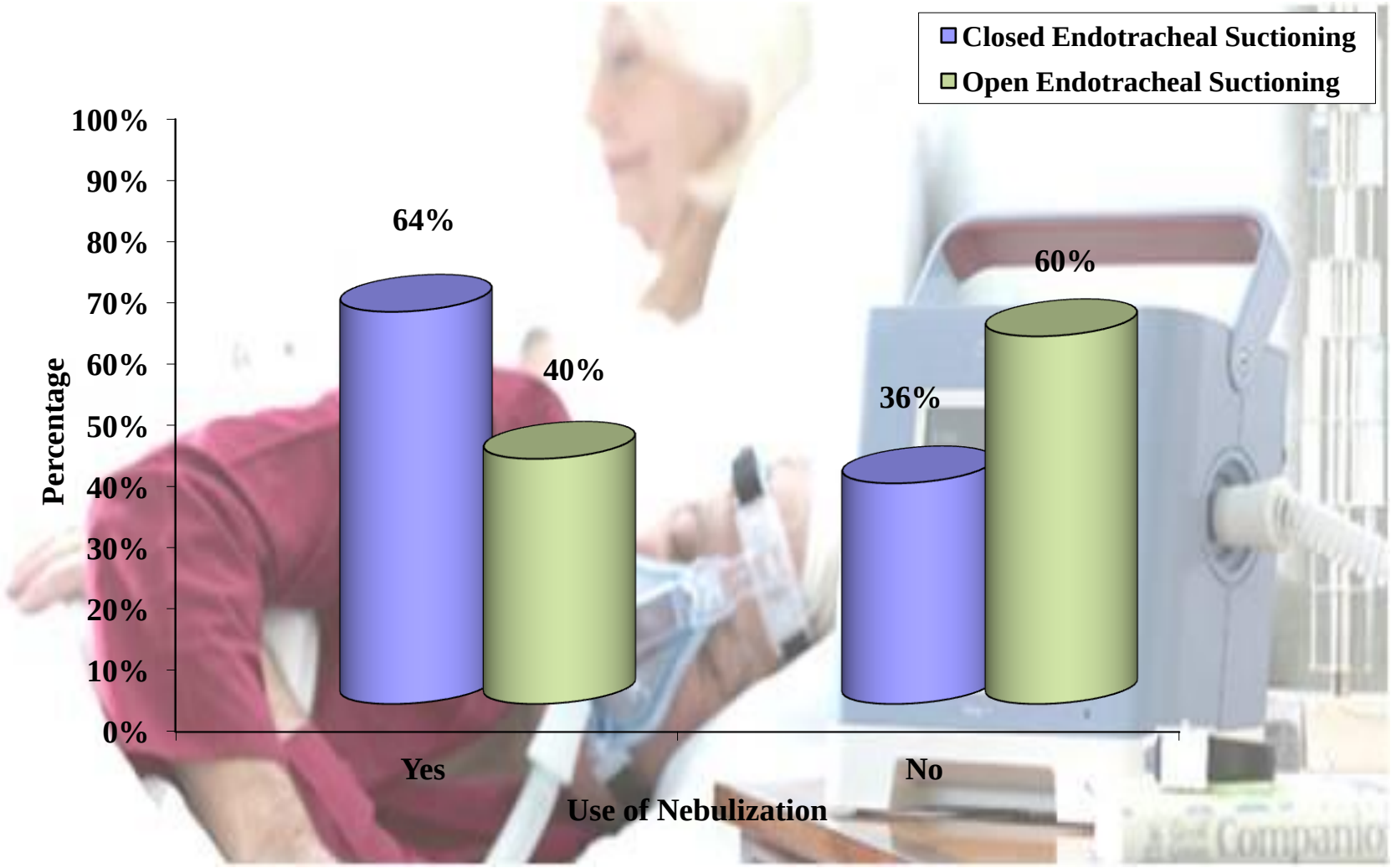

Fig.7 Percentage Distribution of Use of Nebulization in Mechanically Ventilated Adult Patients

Table -3

Comparison of Mean and Standard Deviation of Respiratory Outcome of Mechanically Ventilated Adult Patients with Closed and Open Endotracheal Suctioning

DURATION	Closed Endotracheal Suctioning n=50		Open Endotracheal Suctioning n=50		't' value independent test
	Mean	S.D	Mean	S.D	
Pre observation	33.07	4.49	33.53	3.94	0.54
During suction	28.3	4.53	25.0	4.41	**3.69*** **
After 5 minutes	32.5	4.66	32.6	4.04	0.15
After15 minutes	34.07	4.65	34.2	4.29	0.15

***p < 0.001.

The data represented in table 3 reveals that the mean and standard deviation of post suction respiratory outcome at 15min is high in both the suctioning. In closed endotracheal suctioning, post suction respiratory outcome (mean 34.07 and SD 4.66) is higher than the pre observation (mean 33.07 and SD 4.49). In open endotracheal suctioning, post suction respiratory outcome (mean 34.2 and SD 4.29) is higher than pre observation (mean 33.53 and SD 3.94).

There is a significant difference ($p < 0.001$) in the respiratory outcome during suction between CES and OES (t=3.69). Hence, the null hypothesis Ho_1 "There will be no significant difference in respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients" was rejected.

Table -4

Comparison of Paired't' Test of Respiratory Outcome of Mechanically Ventilated Adult Patients with Closed and Open Endotracheal Suctioning

(N=100)

DURATION	Closed Endotracheal Suctioning 't' value	Open Endotracheal Suctioning 't' value
Pre observation & during suction	22.38***	35.8***
Pre observation & After 5min	3.56***	6.92***
Pre observation & after 15min	2.57*	1.74

***p < 0.001, *p < 0.05.

Table 4 depicts that there is a major variation noted in the respiratory outcome on both suctioning during suction, but the variation in open endotracheal suctioning (t=35.8) is higher than the closed endotracheal suctioning (t=22.38).

Table 5

Comparison of Mean and Standard Deviation of Respiratory Outcome of Each Category of Mechanically Ventilated Adult Patients with Closed and Open Endotracheal Suctioning

CATEGORY	DURATION	Closed Endotracheal Suctioning n=50		Open Endotracheal Suctioning n=50		't' value
		Mean	SD	Mean	SD	
Vital signs	Pre observation	9.23	1.72	9.2	1.58	0.09
	During suction	7.27	1.59	6.98	1.73	0.88
	After 5 minutes	8.78	1.54	8.38	1.70	1.25
	After 15minutes	9.42	1.55	9.06	1.74	1.09
Signs of respiratory distress	Pre observation	9.73	2.36	9.91	2.29	0.39
	During suction	9.35	2.40	8.97	2.40	0.79
	After 5 minutes	9.7	2.41	9.81	2.27	0.23
	After 15 minutes	10.50	2.47	10.83	1.97	0.73
Ventilator settings	Pre observation	8.04	0.99	7.64	1.28	1.73
	During suction	5.5	1.07	2.28	0.67	3.65*
	After 5 minutes	7.92	1.10	7.62	1.29	1.30
	After 15 minutes	8.02	0.99	7.64	1.28	1.65
Signs of Infection	Observation	6.13	2.76	6.88	2.05	1.56

***p < 0.001.

The data from table 5 reveals that vital signs was within normal limits in closed endotracheal suctioning (CES) during suction (mean 7.27, SD 1.59) while comparing the open endotracheal suctioning (OES) (mean 6.98, SD 1.73), sign of respiratory distress is less in CES (mean 9.35, SD 2.40) while comparing with the OES (mean 8.97, SD 2.40), in ventilator settings CES (mean 5.5, SD 1.07) was better than the OES (mean 2.28, SD 0.67).

But with regard to signs infection OES (mean 6.88, SD 2.05) was better than the CES (mean6.13, SD 2.76). There is a significant difference in the ventilator setting during suction between CES and OES (t=3.65).

Table -6

Frequency and Percentage Distribution of Respiratory Outcome of Mechanically Ventilated Adult Patients with Closed and Open Endotracheal Suctioning.

(N=100)

OBSERVATION	RESPIRATORY OUTCOME							
	Highly positive outcome		Positive outcome		Negative outcome		Highly negative outcome	
	n	p	n	p	n	p	n	p
Closed endotracheal suctioning								
Preobservation	21	42	29	58	0	0	0	0
During suction	6	12	37	74	7	14	0	0
After 5min	21	42	28	56	1	2	0	0
After 15min	33	66	17	34	0	0	0	0
Open endotracheal suctioning								
Preobservation	23	46	27	54	0	0	0	0
During suction	2	4	34	68	14	28	0	0
After 5min	17	34	32	64	1	2	0	0
After 15min	26	52	24	48	0	0	0	0

Table 6 depicts that in closed endotracheal suctioning, majority of patients had positive outcome during preobservation (58%), during suction (74%), after 5minutes (56%) and highly positive outcome (66%) after 15minutes.

In open endotracheal suctioning, majority of patients had positive outcome in pre-observation (54%), during suction (28%) negative outcome and (68%) positive outcome. Most of patients after 5minutes (64%) had positive outcome and (52%) had highly positive outcome after 15minutes.

Fig.8 infers that majority of nurses were satisfied (72%) with closed endotracheal suctioning.

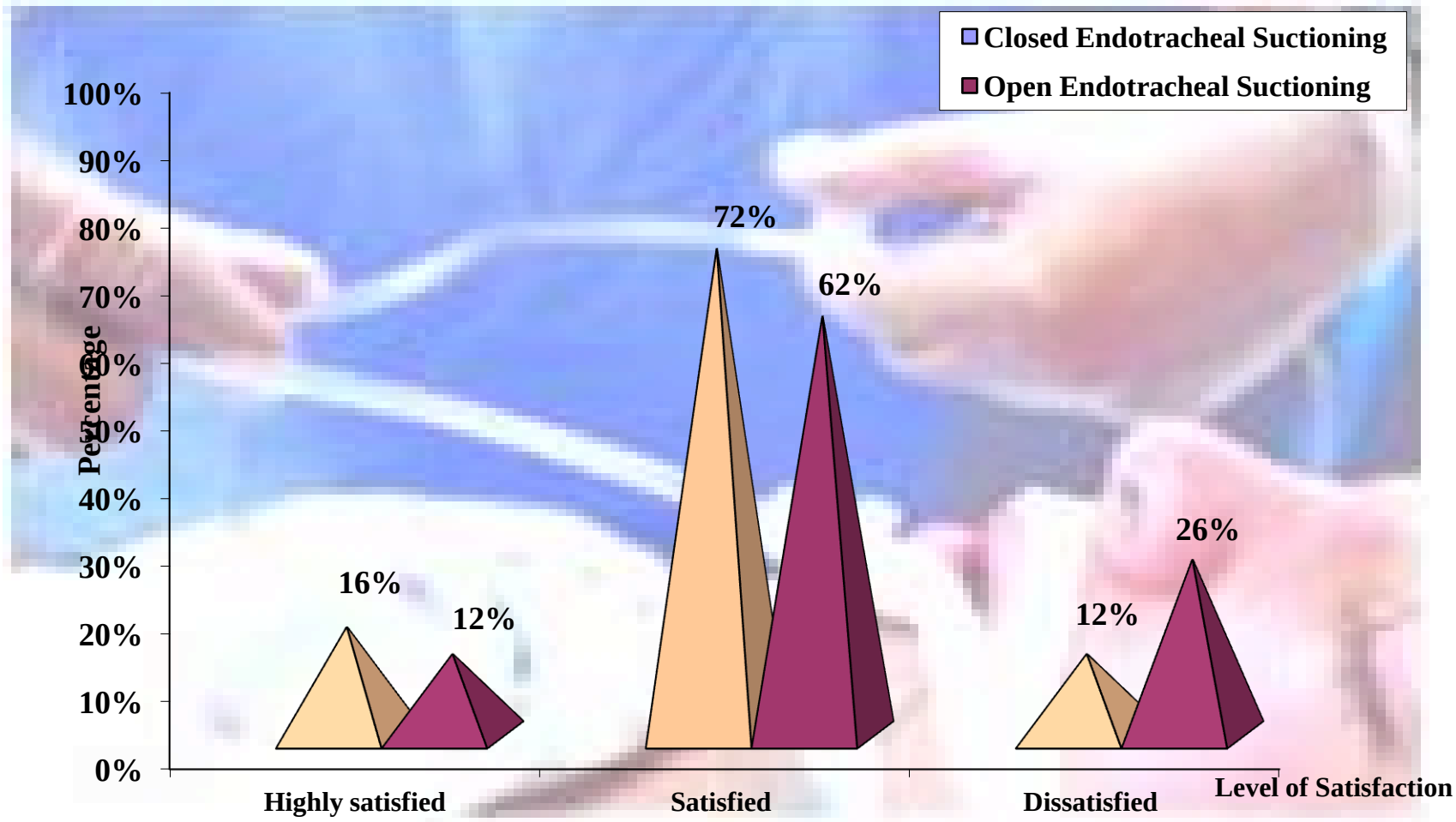

Fig. 8 Percentage Distribution of Level of Satisfaction of Nurses regarding Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients

Table 7

Frequency and Percentage Distribution of Each Category in Level of Satisfaction of Nurses Regarding Respiratory Outcome in Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients.

CONTENT	Closed Endotracheal Suctioning n=50						Open Endotracheal Suctioning n=50					
	Highly satisfied		Satisfied		Dissatisfied		Highly satisfied		Satisfied		Dissatisfied	
	n	p	n	p	n	p	n	p	n	p	n	p
Environment	15	30	30	60	5	10	20	40	28	56	2	4
Method applicability	17	34	31	62	2	4	19	38	29	58	2	4
Patient's benefit	20	40	23	46	7	14	21	42	22	44	7	14
Researcher's approach	22	44	25	50	3	6	22	44	22	44	6	12

The data represented in Table 7 depicts that nurses with open endotracheal suctioning are highly satisfied (40 %) about environment & comfort, (38%) in applicability of the method and (48%) in view of patient's benefit. Nurses using both closed and open endotracheal suctioning (44%) were highly satisfied regarding method and researcher's approach.

Fig.8 infers that 26% of nurses had good performance and 72% had average performance in CES than in the OES which had only 8% of good performance.

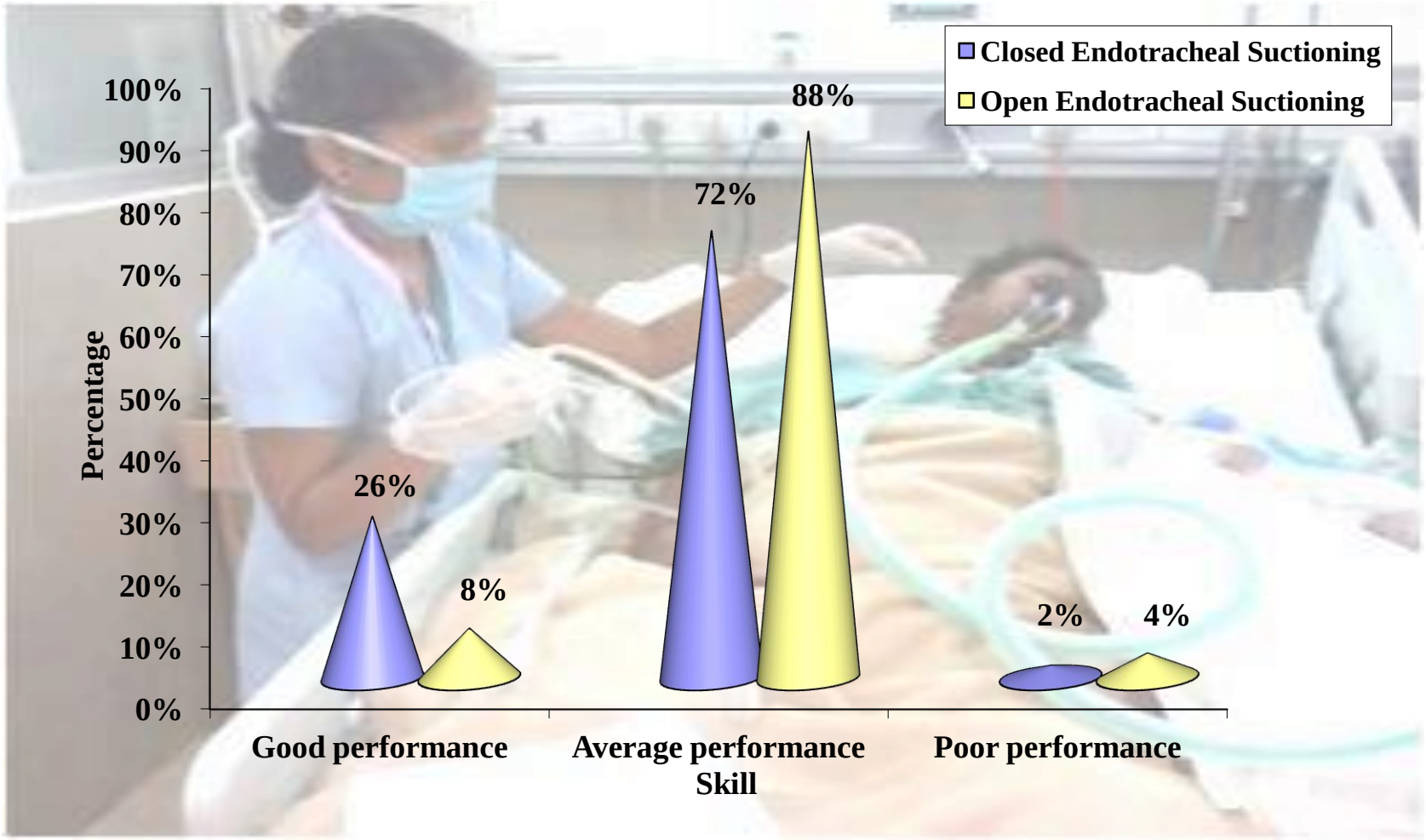

Fig. 9 Percentage Distribution of Practice of Nurses on Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients

Table 8

Frequency and Percentage Distribution of Each Category in Practice of Nurses while Performing Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients

Content	Closed Endotracheal Suctioning n=50						Open Endotracheal Suctioning n=50					
	Good performance		Average performance		Poor performance		Good performance		Average performance		Poor performance	
	n	p	n	p	n	p	n	p	n	p	n	p
Preparation	26	52	17	34	7	14	24	48	18	36	8	16
Skill	25	50	16	32	9	18	23	46	18	36	9	18
Evaluation	32	64	15	30	3	6	28	56	14	28	8	16

The data from Table 8 reveals the nurses had good level of practice in preparation (52%), skill of performing procedure (50%) and evaluation (64%) in closed endotracheal suctioning while comparing the open endotracheal suctioning.

Table 9

Association between the Selected Demographic Variables and Respiratory Outcome in Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients

DEMOGRAPHIC VARIABLE	Closed Endotracheal Suctioning n=50						Open Endotracheal Suctioning n=50					
	Before suction			After suction			Before suction			After suction		
	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2
Age in years												
≤40	6	9	1.23	6	9	0.85	7	12	1.52	12	7	1.03
>40	20	15	(df=1)	19	16	(df=1)	17	14	(df=1)	15	16	(df=1)
Gender												
Male	14	18	2.42	15	17	0.34	16	18	0.51	20	14	0.99
Female	12	6	(df=1)	10	8	(df=1)	8	8	(df=1)	7	9	(df=1)
Occupation												
Employed	10	12	0.67	10	12	0.32	10	13	0.34	15	8	2.15
others	16	12	(df=1)	15	13	(df=1)	14	23	(df=1)	12	27	(df=1)
Place of work												
Indoor	19	14	1.20	19	14	2.29	15	15	0.12	14	16	1.62
Outdoor	7	10	(df=1)	6	11	(df=1)	9	11	(df=1)	13	7	(df=1)

Nature of work												
Sedentary	15	13	0.062	15	13	0.32	13	16	0.27	16	13	0.04
Moderate and heavy	11	11	(df=1)	10	12	(df=1)	11	10	(df=1)	11	10	(df=1)
History of smoking												
Yes	7	5	1.23	7	5	0.34	5	8	0.64	9	4	1.64
No	19	19	(df=1)	18	20	(df=1)	19	18	(df=1)	18	19	(df=1)
History of alcoholism												
Yes	6	9	1.23	8	7	0.09	3	7	1.62	7	3	1.28
No	20	15	(df=1)	7	18	(df=1)	21	19	(df=1)	20	20	(df=1)

*$p < 0.05$.

Note: Categories under the variables were clubbed for the sake of chi-square analysis.

It could be inferred from Table 11 that there is no significant association between respiratory outcome other demographic variables like age, gender, occupation, place of work, nature of work, history of smoking and history of alcoholism ($p>0.05$). In this regard, the null hypothesis Ho_2 "There will be no significant association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients" was retained.

Table 10

Association between the Selected Clinical Variables and Respiratory Outcome in Closed and Open Endotracheal Suctioning in Mechanically Ventilated Adult Patients

CLINICAL VARIABLE	Closed Endotracheal Suctioning n=50						Open Endotracheal Suctioning n=50					
	Before suction			After suction			Before suction			After suction		
	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2	Upto mean	Above mean	χ^2
Diagnosis												
Respiratory disease	6	1		5	2		2	1		2	1	
Cardiovascular disease	6	2		7	1		0	0		0	0	
Neurological disease	7	10		7	10		13	17		18	12	
Gastro intestinal disease	2	6	8.6 (df=4)	3	5	**9.52*** (df=4)	2	2	1.43 (df=4)	3	1	5.88 (df=4)
Others	5	5		3	7		7	6		4	9	
Reason for mechanical ventilation												
Respiratory failure	8	3		8	3		4	1		2	3	
Disease prevents from normal breathing	5	7	5.86	5	7	**11.71***	5	9	4.78	9	5	3.91
Trauma / sepsis	9	5	(df=3)	10	4	(df=3)	7	11	(df=3)	11	7	(df=1)
Others	4	9		2	11		8	5		5	8	
Body mass index												
Underweight & normal	18	17		15	10		8	15		14	9	
Overweight & obese	8	7	**8.01**** (df=1)	10	15	**6.63**** (df=1)	16	11	2.98 (df=1)	13	14	0.8 (df=1)

No of days												
1 to 3	16	22	**11.22***	11	21	**8.6****	22	18	**3.92***	20	20	1.2
More than 4 days	14	2	** (df=1)	14	4	(df=1)	2	8	(df=1)	7	3	(df=1)
Alertness												
Conscious	13	14	0.34	14	12	0.32	14	7	**5.05***	10	11	0.59
Sedated	13	10	(df=1)	11	13	(df=1)	10	19	(df=1)	17	12	(df=1)
Vacuum pressure												
0-200mmhg	0	0	0	0	0	0	0	0	0	0	0	0
201-300mmhg	26	24	(df=1)	25	25	(df=1)	24	26	(df=1)	27	23	(df=1)
Chest physiotherapy												
Yes	14	8	2.13	14	8	2.92	5	9	1.17	10	4	2.37
No	12	16	(df=1)	11	17	(df=1)	19	17	(df=1)	17	19	(df=1)
Humidifier												
Yes	14	6	**4.32***	14	6	**5.3***	2	5	1.23	5	2	0.99
No	12	18	(df=1)	11	19	(df=1)	22	21	(df=1)	22	21	(df=1)
Nebulization												
Yes	20	22	2.01	19	13	3.12	9	11	0.12	11	9	0.01
No	6	2	(df=1)	6	12	(df=1)	15	15	(df=1)	16	14	(df=1)
History of previous respiratory illness												
Yes	5	3	0.42	4	4	0	1	2	0.27	2	1	0.20
No	21	21	(df=1)	21	21	(df=1)	23	24	(df=1)	25	22	(df=1)
History of co-morbid illness												
Yes	16	11	1.23	15	12	0.72	12	14	0.07	14	12	0.005
No	10	13	(df=1)	10	13	(df=1)	12	12	(df=1)	13	11	(df=1)
Treatment of co-morbid illness												
Yes	15	12	0.29	15	12	0.72	12	13	0	13	12	0.08
No	11	12	(df=1)	10	13	(df=1)	12	13	(df=1)	14	11	(df=1)

History of trauma												
Yes	3	3	0.01	4	2	0.75	3	11	**5.50****	11	3	**4.72***
No	23	21	(df=1)	21	23	(df=1)	21	15	(df=1)	16	20	(df=1)
History of surgery												
Yes	8	6	0.20	6	8	0.39	4	8	1.36	7	5	0.12
No	18	18	(df=1)	19	17	(df=1)	20	18	(df=1)	20	18	(df=1)

*p < 0.05, **p < 0.01, ***p < 0.001.

Note: Categories under the variables were clubbed for the sake of chi-square analysis.

It could be inferred from Table 10 that there is a significant association between the diagnosis, reason for mechanical ventilation, body mass index, alertness, no of days, humidifier, history of trauma of patients and the respiratory outcome at ($p < 0.05$) level.

However there is no significant association between other clinical variables like vacuum pressure, chest physiotherapy, nebulization, history of previous respiratory illness, history of co-morbid illness, treatment of co-morbid illness, history of surgery and respiratory outcome ($p>0.05$).

Hence the null hypothesis Ho_3 "There will be no significant association between the clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients" was partially rejected.

Summary

This chapter has dealt with the analysis and interpretation of the data obtained by the researcher. The analysis of the results showed that the respiratory outcome was better in the closed endotracheal suctioning than the open endotracheal suctioning. This can be credited to the effectiveness of closed endotracheal suctioning.

CHAPTER V

DISCUSSION

An Evaluative Study to Assess the Effectiveness of Closed Endotracheal Suctioning as Against Open Endotracheal Suctioning upon Respiratory Outcomes in Mechanically Ventilated Adult Patients at Selected Hospitals, Chennai.

Objectives of the Study

1. To assess the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
2. To determine the effectiveness of method of endotracheal suctioning by comparing the respiratory outcome before and after closed and open endotracheal suctioning in mechanically ventilated adult patients.
3. To assess the level of satisfaction of nurses regarding closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
4. To assess the level of practice of nurses on closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
5. To find out the association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
6. To find out the association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

The study was carried out upon 100 mechanically ventilated adult patients at selected hospitals Chennai. The respiratory outcome was assessed in closed and open endotracheal suctioning by using observational check list. The respiratory outcome was observed before suction, during suction, 5min and 15min after suction in both endotracheal suctioning. The observation was done for 3 consecutive days for each patient. Then the level of satisfaction of nurses was assessed using rating scale and the level of practice of nurses was also assessed by using practice observational checklist in closed and open endotracheal suctioning.

The discussion is presented under the following headings

- Demographic variables of closed endotracheal suctioning and open endotracheal suctioning of mechanically ventilated adult patients.
- Clinical variables of closed endotracheal suctioning and open endotracheal suctioning of mechanically ventilated adult patients.
- Effectiveness of closed and open endotracheal suctioning on respiratory outcome.
- Comparison of mean and standard deviation of respiratory outcome of each category of mechanically ventilated adult patients in closed and open endotracheal suctioning.
- Association between the selected demographic variables and clinical variables and respiratory outcome in closed and open endotracheal suctioning in mechanically ventilated adult patients.
- Level of satisfaction of nurses in closed and open endotracheal suctioning in mechanically ventilated adult patients.

- Level of practice of nurses in closed and open endotracheal suctioning in mechanically ventilated adult patients.

Demographic variables of closed endotracheal suctioning and open endotracheal suctioning of mechanically ventilated adult patients.

Majority of the mechanically ventilated adult patients in closed and open endotracheal suctioning were aged between 51-60 years (52%, 46%), male (64%, 68%), employed (44%, 46%), indoor worker (66%, 60%), sedentary workers (56%, 58%), both history of smoking (24%, 26%) and alcoholism (30%, 20%) respectively.

Age is one of the critical factors affecting the mortality rates among mechanically ventilated patients. Feng Y. et al. (2009) conducted a study to assess the age, duration of mechanical ventilation (MV) and outcomes of patient who are critically ill. Among 4,238 who received invasive MV 11.7% of patients < 65 years of age who received MV for 1 or 2 days died during hospitalization, the mortality rate increased to 72.1% for patients > 85 years of age who had received MV for > 7 days. This study suggests that age and duration of MV are strongly associated with mortality rates.

In this study, a significant percentage of patients belong to the age group of 51-60 years in both closed and open endotracheal suctioning. This shows that the incidence and need for mechanical ventilation increases with age.

Males are strongly related to the need for medical attention. Most of the patients in the present study are employed and were indoor sedentary workers. History of smoking and alcoholism may act as contributing factors for poor respiratory outcome among these mechanically ventilated adult patients.

Clinical variables of closed endotracheal suctioning and open endotracheal suctioning of mechanically ventilated adult patients.

Most of the mechanically ventilated adult patients in both closed and open endotracheal suctioning in this study were diagnosed to have neurological disease (34%, 60%), ventilated for trauma/shock (28%, 36%), overweight (42%, 50%), 1 to 3 days of ventilation (64%, 80%), consciousness (56%, 42%), required physiotherapy (56%, 28%), humidifier (40%, 14%), patient received nebulization (64%, 40%), previous history of respiratory illness (16%, 6%), patient with co-morbid illness (52%, 52%), treatment for co-morbid illness (54%, 50%), had history of trauma (12%, 28%) and surgery (28%, 24%) respectively.

Findings in the clinical variables reveal that most of the client who receives mechanical ventilation had neurological disorders. Most of the client with head injury and neuromuscular disorder need more and prolonged mechanical ventilation support. Corno et al. (2005) conducted a study to characterize the need for mechanical ventilation following cervical spinal cord injury with neurologic deficit. Among 45 completely injured patients of C6 level and below, 79% received definite airway, 50% required tracheostomy and 15% of survivors required mechanical ventilation at hospital discharge.

Body mass index has its greater influence on respiratory outcome in mechanically ventilated patient. In this present study, most of the patients were overweight. Thus, it was supported by Anzueto A. et al. (2012) who conducted a study to analyse the influence of body mass index on respiratory outcome of mechanically ventilated patients.

Among 4698 ventilated patients, 35.8% are overweight and 20.2% are obese. The body mass index was significantly associated with the development of acute respiratory distress syndrome. The study concluded that obese patients were more likely to have significant complication but there was no association with increased mortality.

Many studies have concluded that more the number of days on ventilator, higher the risk of development of complication and infection. In this study most of the patients had ventilation for duration of 1 to 3 days and were conscious during mechanical ventilation. Chest physiotherapy is a defined measure to improve the respiratory efficiency, promote lung expansion, strengthen respiratory muscles, and mobilizing secretions from the respiratory system. In closed endotracheal suctioning most of the patient received chest physiotherapy and humidifier use.

Nebulization used for softening mucus and facilitating removal of secretions in mechanically ventilated adult patients. It was found to be effective than instilling distilled water as suggested by the study of Kolckare M. et al. (2006). There is also a lack of evidence regarding the amount of secretion removed by closed suction is effective or not. But the need for chest physiotherapy and nebulization is higher for closed endotracheal suctioning than the open endotracheal suctioning.

The impact of previous history of respiratory illness among mechanical ventilated patients upon respiratory outcome was found to be less in this study. In the present study, most of them had a co-morbid illness in both endotracheal suctioning which may be a contributing factor for developing complication. Treatment for co-morbid illness was taken by both groups. History of surgery had lesser influence upon respiratory outcome on mechanically ventilated adult patients.

Effectiveness of closed and open endotracheal suctioning on respiratory outcome.

Mean and standard deviation in the respiratory outcome of the mechanically ventilated adult patients before performing closed and open endotracheal suctioning was (M-33.07, 33.53 & SD- 4.49, 3.94) whereas there is a significant decline at the time of suction (M-28.3, 25 & SD- 4.53, 4.41). The mean and standard deviation of post suction respiratory outcome after 15min was high in closed and open endotracheal suctioning (M- 34.07, 34.2 & SD- 4.66, 4.29) respectively.

American Association for Respiratory Care (AARC) clinical practice guidelines suggest that the use of closed suction is suggested for adults with high FiO2, PEEP, at risk for lung de-recruitment, and for neonates. Hence, it is concluded that closed endotracheal suctioning has good respiratory outcome than the open endotracheal suctioning.

Comparison of mean and standard deviation of respiratory outcome of each category of mechanically ventilated adult patients in closed and open endotracheal suctioning.

Mean and standard deviation of respiratory outcome of each category is noted in both the suctioning systems. The vital signs was within normal limits in closed endotracheal suctioning (CES) during suction (mean 7.27 & SD 1.59) while comparing to the open endotracheal suctioning (OES) (mean 6.98 & SD 1.73) and sign of respiratory distress is significantly lower in CES (mean 9.35 & SD 2.40) while comparing the OES (mean 8.97 & SD 2.40). There is a significant difference ($p< 0.001$) in the respiratory outcome during suction between CES and OES ($t=3.69$). Hence, the null hypothesis Ho_1 was rejected.

Zolfaghari M, et al.(2008) conducted a study to assess the effect of open and closed endotracheal suctioning on vital signs of ICU patients. Blood pressures and heart rate showed higher increase 2 and 5 minutes after the open method. Arterial blood oxygen saturation reduced in the open method more than in the closed (P<0.001). No significant difference was seen in the patients' respiratory rate in two methods (P>0.05).

CES results in lower disturbances in the vital signs than OES. Therefore, to obtain better results upon respiratory outcome, the closed endotracheal suctioning is suggested. In the present study also vital signs were within normal limit in CES (mean 7.27 & SD 1.59) while comparing the OES (mean 6.98 & SD 1.73).

In the present study, the ventilator settings in CES (mean 5.5 & SD 1.07) were better than the OES (mean 2.28 & SD 0.67). It has been supported by the study conducted by El Masry A, et al. (2005) to assess the impact of closed endotracheal suctioning system on mechanical ventilator performance with 11 ventilators. Closed suctioning does not cause mechanical ventilator malfunction. However, closed suctioning can decrease end-expiratory pressure during suctioning.

Similarly, the signs of infection in OES (mean6.88 & SD 2.05) were lesser than the CES (mean6.13 & SD 2.76). CES failed to reduce cross contamination in this study but it is not significantly noted. Many studies have suggested that closed suction system will increase the process of colonization but it has not been significantly proved in this present study.

Association between the selected demographic variables and clinical variables and respiratory outcome in closed and open endotracheal suctioning in mechanically ventilated adult patients.

Chi square test was used to find out the association between selected demographic variables and the respiratory outcome, inferred that there was no significant association between the respiratory outcome and the selected demographic variable ($p>0.05$). In this regard, the null hypothesis Ho_2 was retained.

There was a significant association between the respiratory outcome and the selected clinical variables of body mass index ($\chi^2=8.01$, df=1), ($p<0.01$), number of days on ventilator ($\chi^2=11.22$, df=1), ($p<0.001$), humidifier ($\chi^2=4.32$, df=1), ($p<0.05$) before suction and after suction diagnosis ($\chi^2=9.52$, df= 4), ($p<0.05$), reason for mechanical ventilation($\chi^2=11.71$, df= 3), ($p<0.05$) , body mass index ($\chi^2=6.63$, df= 1), ($p<0.01$), number of days on ventilator ($\chi^2=8.6$, df=1), ($p<0.01$), humidifier ($\chi^2=5.3$, df=1), ($p<0.05$) in closed endotracheal suctioning.

There was a significant association between the respiratory outcome and the selected clinical variables of alertness ($\chi^2=5.05$, df= 1), ($p<0.05$), number of days on ventilator ($\chi^2=3.92$, df=1), ($p<0.05$), and history of trauma ($\chi^2= 5.50$, df=1), ($p<0.01$) before suction and after suction history of trauma ($\chi^2= 4.72$, df=1), ($p<0.05$) in open endotracheal suctioning.

However there is no significant association between other clinical variables like vacuum pressure, chest physiotherapy, nebulization, history of previous respiratory illness, history of co-morbid illness, treatment of co-morbid illness, history of surgery and respiratory outcome ($p>0.05$). Hence, the null hypothesis Ho_3 was partially rejected.

Anzueto A, et al. (2011) conducted a study to find the impact of body mass index on outcomes in mechanically ventilated patients. Among 184 patients (3.7%) were underweight, 1995 patients (40%) had normal weight, 1781 patients (35.8%) were overweight, 792 patients (15.9%) were obese and 216 patients (4.3%) were severely obese. Severely obese patients were more likely to receive low tidal volume based on actual body weight but high volumes based on predicted body weight. In obese patients, the authors observed a higher incidence of acute respiratory distress syndrome and acute renal failure. In this cohort, obese patients were more likely to have significant complications but there were no associations with increased mortality rate.

So, the clinical variable such as diagnosis, reason for mechanical ventilation, type of airway, body mass index, alertness, humidifier and history of trauma are the risk factors for the poor respiratory outcome and require more attention.

Level of satisfaction of nurses in closed and open endotracheal suctioning in mechanically ventilated adult patients.

The 16% of nurses are highly satisfied with CES 72% were satisfied and 12% were dissatisfied. In OES 12% nurses were highly satisfied, 62% were satisfied and 26% were dissatisfied.

Hence, majority of nurses were highly satisfied with closed endotracheal suctioning and it could be implemented for mechanically ventilated adult patient.

Level of practice of nurses in closed and open endotracheal suctioning in mechanically ventilated adult patients.

In closed endotracheal suctioning, 26% of nurses had good performance skill, 72% of nurses had average performance skill and only 2% nurse had a poor

performance. Majority of nurses 88% had average performance and 4% had poor performance in open endotracheal suctioning. Hence, from the present study it is proved that the need for evidence based education is required for the nurses to improve their practice competence.

Day T, et al. (2002) conducted a study to explore nurses' knowledge and competence in performing tracheal suctioning in acute and high dependency ward areas and to investigate discrepancies between knowledge and practice using method triangulation among 28 nurses. The findings demonstrated a poor level of knowledge for many subjects. This was also reflected in practice, as suctioning was performed against many of the research recommendations.

Many nurses were unaware of recommended practice and a number demonstrated potentially unsafe practice. In addition, there was no significant relationship between knowledge and practice. The study raised concern about all aspects of tracheal suctioning and has highlighted the need for changes in practice, clinical guidelines and focused practice-based education.

Summary

This chapter dealt with the objectives of the study, major findings of the demographic variables and clinical variables of the mechanically ventilated patients, mean and standard deviation in respiratory outcome of mechanically ventilated adult patients before and after endotracheal suctioning, association between the selected demographic and clinical variables and respiratory outcome of the mechanically ventilated adult patients, the level of satisfaction of nurses and the practice of nurses in both closed and open endotracheal suctioning in mechanically ventilated adult patients.

CHAPTER VI

SUMMARY, CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

SUMMARY

The aim of the study is to assess the effectiveness of closed and open endotracheal suction system upon respiratory outcome in mechanically ventilated adult patients.

Objectives of the Study

1. To assess the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
2. To determine the effectiveness of method of endotracheal suctioning by comparing the respiratory outcome before and after closed and open endotracheal suctioning in mechanically ventilated adult patients.
3. To assess the level of satisfaction of nurses regarding closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
4. To assess the level of practice of nurses on closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.
5. To find out the association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

6. To find out the association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

The study utilized the evaluative approach and the study was conducted in Apollo Speciality Hospital (OES) and Apollo Main Hospital (CES). 100 mechanically ventilated adult patients were selected by simple random sampling technique. Out of which 50 patients were taken for CES group and 50 patients were taken for OES. Respiratory outcome was assessed in both groups before and after endotracheal suctioning. Respiratory outcome was assessed 5min before suctioning, during the suction, 5 min and 15min after suctioning in closed and open endotracheal suctioning respectively.

Null Hypothesis

Ho_1 There will be no significant difference in respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Ho_2 There will be no significant association between the selected demographic variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Ho_3 There will be no significant association between the selected clinical variables upon the respiratory outcome before and after closed endotracheal suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

The conceptual frame work for this study is based on Wiedenbach's Helping Art of Clinical Nursing Theory (1964). An extensive literature review and guidance by the experts formed foundations for the development of the tool. An evaluative research approach was used to achieve the objectives of the study.

The investigator used the demographic variable proforma, clinical variable proforma, checklist to assess the respiratory outcome, level of satisfaction of nurses and practice of nurses. The data collection tools were validated and reliability was established. After the pilot study, the data for the main study was collected. The collected data was tabulated and analyzed using descriptive and inferential statistics.

Major Findings of the Study

Demographic variables of mechanically ventilated adult patients with endotracheal suctioning.

Majority of the mechanically ventilated adult patients in closed and open endotracheal suctioning were aged between 51-60years (52%, 46%), male (64%, 68%), employed (44%, 46%), indoor worker (66%, 60%), sedentary workers (56%, 58%), both history of smoking (24%, 26%) and alcoholism (30%, 20%) respectively.

Clinical variables of mechanically ventilated adult patients with endotracheal suctioning.

Most of the mechanically ventilated adult patients in both closed and open endotracheal suctioning in this study were diagnosed to have neurological disease (34%, 60%), ventilated for trauma/shock (28%, 36%), overweight (42%, 50%), 1 to 3 days of ventilation (64%, 80%), consciousness (56%, 42%), required physiotherapy (56%, 28%), humidifier (40%, 14%), received nebulization (64%, 40%), previous

history of respiratory illness (16%, 6%), patient with co-morbid illness (52%, 52%), treatment for co-morbid illness (54%, 50%), had history of trauma (12%, 28%) and surgery (28%, 24%) respectively.

Effectiveness of closed and open endotracheal suctioning on respiratory outcome.

Mean and standard deviation in the respiratory outcome of the mechanically ventilated adult patients before performing closed and open endotracheal suctioning was (M-33.07, 33.53 & SD- 4.49, 3.94), whereas there is a significant decline at the time of suction (M-28.3, 25 & SD- 4.53, 4.41). The mean and standard deviation of post suction respiratory outcome after 15min was high in closed and open endotracheal suctioning (M- 34.07, 34.2 & SD- 4.66, 4.29) respectively.

There is a significant difference ($p<0.001$) in the respiratory outcome during suction between CES and OES ($t=3.69$). Hence, the null hypothesis Ho_1 was rejected.

Comparison of mean and standard deviation of respiratory outcome of each category of mechanically ventilated adult patients in open and closed suction system.

Vital signs was within normal limits in closed endotracheal suctioning (CES) during suction (mean 7.27, SD 1.59) while comparing with the open endotracheal suctioning(OES) (mean 6.98, SD 1.73), sign of respiratory distress was less in CES (mean 9.35, SD 2.40) while comparing with the OES (mean 8.97, SD 2.40), in ventilator settings CES (mean 5.5, SD 1.07) was better than the OES (mean 2.28, SD 0.67). The signs of infection in OES (mean6.88, SD 2.05) were lesser than CES (mean6.13, SD 2.76). There was a significant difference in ventilator setting during suction in between the groups ($t=3.65$).

Level of satisfaction of nurses in closed and open suctioning in mechanically ventilated adult patients.

In this study, 16% of nurses were highly satisfied with CES 72% were satisfied and 12% were dissatisfied. In OES, 12% nurses were highly satisfied, 62% were satisfied and 26% were dissatisfied.

Level of practice of nurses in closed and open suction system in mechanically ventilated adult patients.

The present study reveals that in CES, 26% of nurses had good performance skill, 72% of nurses had average performance skill and only 2% nurse had a poor performance. Majority of nurses had average performance (88%) and 4% had poor performance in OES.

Association between the selected demographic variables and clinical variables and the respiratory outcome of mechanically ventilated adult patients.

Chi square test was used to find out the association between selected demographic variables and the respiratory outcome, inferred that there was no significant association between the respiratory outcome and the selected demographic variable ($p>0.05$). In this regard, the null hypothesis Ho_2 was retained.

There was a significant association between the respiratory outcome and the selected clinical variables of body mass index ($\chi^2=8.01$, df=1), ($p<0.01$), number of days on ventilator ($\chi^2=11.22$, df=1), ($p<0.001$), humidifier ($\chi^2=4.32$, df=1), ($p<0.05$) before suction and after suction diagnosis ($\chi^2=9.52$, df= 4), ($p<0.05$), reason for mechanical ventilation($\chi^2=11.71$, df= 3), ($p<0.05$) , body mass index ($\chi^2=6.63$, df= 1), ($p<0.01$),

number of days on ventilator (χ^2=8.6, df=1), ($p<0.01$), humidifier (χ^2=5.3, df=1), ($p<0.05$) in closed endotracheal suctioning.

There was a significant association between the respiratory outcome and the selected clinical variables of alertness (χ^2=5.05, df= 1), ($p<0.05$), number of days on ventilator (χ^2=3.92, df=1), ($p<0.05$), and history of trauma (χ^2= 5.50, df=1), ($p<0.01$) before suction and after suction history of trauma (χ^2= 4.72, df=1), ($p<0.05$) in open endotracheal suctioning. Hence, the null hypothesis Ho_3 was partially rejected.

Conclusion

The findings of the study revealed that the respiratory outcome is better in closed endotracheal suctioning whereas major variation is noted in the open endotracheal suctioning. Thus, study concludes that closed endotracheal suctioning is the best method for mechanically ventilated adult patients.

Implications

Based on the findings the researcher recommends the implications on Nursing practice, Nursing administration, Nursing education, Nursing research.

Nursing practice

The findings of the study revealed that the mechanically ventilated patients in intensive care unit are in need of suctioning frequently to maintain the patent airway. The closed and open endotracheal suctioning system is found to have better respiratory outcome. The best effective strategies of suctioning are preoxygenation and post oxygenation should be mandatory, frequent instillation of distilled/sterile water need to be avoided, duration of suction should be less than 15sec, must follow a circulatory movement and the suction tubing need to be cleansed well after the procedure.

With the above mentioned strategies closed endotracheal suctioning is found to be effective. All nurses play a vital role in caring the mechanically ventilated patients. Strategies/policies can be formed for the nurses to follow a better suction system.

Nursing education

With the emerging health care demands and newer trends in the field of nursing education, we must focus on the innovations to enhance the nursing care. The nursing students should be taught the proper protocol in performing the procedure. Therefore student nurses should be taught the clinical importance of endotracheal suctioning for maintaining patent airway. Demonstration of proper technique and use of simulation in the clinical setup helps the students to acquire an adequate knowledge and incorporate it in their practice.

Nursing administration

With technological advances and ever growing challenges of health care, administrators have the responsibility to provide continuing nursing education opportunities to understand the intervention in improving the respiratory outcome.

This enables the nurses to update the knowledge and to render the cost effective care to the public. The nurse administrators can train the nurses to identify the best method. Nurse administrators must periodically organize formal training programme to the nurses. Awareness can be created among the nurses regarding the benefits of closed suction system in order to promote its use in clinical set up.

Nursing research

The professionals and the students can conduct further studies on infection precaution in both interventions. There is a need for extensive research in this area. Nurse researcher should appraise challenges and should perform scientific work by

taking part in assessment, applications, evaluation for mechanically ventilated patients. The researcher can bring the researched technique into practice.

Researchers must focus on various measures in maintaining patent airway and develop appropriate protocol for attaining early weaning of mechanically ventilated patients and thus minimizing the complication. Closed endotracheal suctioning system can be implemented to mechanically ventilated patients to attain a better respiratory outcome.

Recommendations

- A study can be conducted on infection precautions in closed and open endotracheal suctioning system among mechanically ventilated adult patients.
- Study can be conducted to assess the incidence of ventilator associated pneumonia (VAP) in closed and open endotracheal suctioning system among mechanically ventilated adult patients.
- Study can be conducted on cost effectiveness in closed and open endotracheal suctioning system among mechanically ventilated patients.
- Study can be conducted to assess the various other problems in mechanically ventilated patients.
- A study can be conducted for tracheal closed and open endotracheal suctioning patients.
- A similar study can be done on mechanically ventilated preterm neonates
- A similar study can be done on a larger population for more valid generalization.
- The study can be conducted in the other settings like the community and the hospitals.

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APPENDIX I

LETTER SEEKING PERMISSION TO CONDUCT THE STUDY

Apollo College of Nursing
(Recognised by the Indian Nursing Council and Affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai)

CO/0286/12 **11.06.12**

To

Dr.Radha Rajagopalan,
Director of Medical Education,
Apollo Main Hospital,
21, Greams Lane (Off Greams Road),
Chennai – 600 006.

Respected Madam,

Sub.: To request permission for research study – Reg.

Greetings! As part of the curriculum requirement our 2nd year M. Sc. (N) student Ms.Famila Jane Christiana Y. has selected the following title for her research study.

"An evaluative study to assess the effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients at selected hospitals, Chennai".

So I kindly request your goodselves to permit her to conduct study in your esteemed institution.

Thanking You,

Dr. LATHA VENKATESAN
PRINCIPAL

IS/ISO 9001:2000

Vanagaram to Ambattur Main Road, Ayanambakkam, Chennai - 600 095.
Ph. : 044 - 2653 4387 Tele fax : 044 - 2653 4923 / 044- 2653 4386

To Dr Ramakrishnan / Dr. Didipya
To kindly allow the Students to do this
should be OK
12/6

Apollo College of Nursing

(Recognised by the Indian Nursing Council and Affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai)

CO/0287/12 ***11.06.12***

To,
The Nursing Superintendent,
Apollo Speciality Hospital,
320, Anna Salai,
Nandanam, Tenampet,
Chennai – 600 035.

Respected Madam,

Sub.: *To request permission for research study – Reg.*

Greetings! *As part of the curriculum requirement our 2nd year M. Sc. (N) student Ms.Famila Jane Christiana Y. has selected the following title for her research study.*

"An evaluative study to assess the effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients at selected hospitals, Chennai".

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APPENDIX II

ETHICAL COMMITTEE CLEARANCE LETTER

Ethics Committee

Apollo HOSPITALS
TOUCHING LIVES

30th August 2012

To,

Ms. Famila Jane Christiana Y,
2nd Year M.SC (Nursing),
Department of Medical Surgical Nursing,
Apollo College of Nursing,
Chennai.

Ref: Effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respirator outcome in mechanically ventilated adult patients.

Sub: Approval of the above referenced project and its related documents.

Dear Ms. Famila,

Ethics Committee-Apollo Hospitals has received the following document submitted by you related to the conduct of the above-referenced study.

- Project proposal.
- Participant Consent Form.

The Ethics Committee-Apollo Hospitals reviewed and discussed the study proposal documents submitted by you related to the conduct of the above referenced study at its meeting held on 29th August 2012.

The following Ethics Committee Members were present at the meeting held on 29th August 2012.

Name	Profession	Position in the committee
Mr. S. S. Narayanan	Ethicist	Chairman
Dr. Rema Menon	Clinician	Member Secretary
Dr. Radha Rajagopalan	Clinician	EC-Member
Dr. Krishnakumar	Clinician	EC-Member

Apollo Hospitals Enterprise Limited
21, Greams Lane, Off Greams Road, Chennai - 600 006
Tel : 91 - 44 - 2829 3333 Extn : 6008, 91 - 44 - 2829 5465 Extn : 6639 Fax : 91 - 44 - 2829 4449
E - Mail : ecapollochennai@gmail.com

Dr. Vijaya Kumar	Clinician	EC-Member
Dr. Clive Fernandes	Consultant Clinical Pharmacologist	Basic Medical Scientist
Dr. Nalini Roa	Social Worker	EC-Member
Ms. N. Suseela	Retired English Teacher	Layperson
Ms. Maimoona Badsha	Lawyer	Lawyer
Dr. Paul Dilipkumar	Clinician	EC-Member
Dr. V. Balaji	Clinician	EC-Member
Dr. M. A. Raja	Consultant Medical Oncologist	EC-Member

After due ethical and scientific consideration, the Ethics Committee has approved the above presentation submitted by you.

The EC review and approval of the report is only to meet their academic requirement and will not amount to any approval of their conclusions/recommendations as conclusive, deserving adoption and implementation, in any form, in any health care institution.

The Ethics Committee is constituted and works as per ICH-GCP, ICMR and revised Schedule Y guidelines.

With Regards,

Rema Menon

Dr. Rema Menon,
Ethics Committee-Member Secretary,
Apollo Hospitals, Chennai,
Tamil Nadu, India.

Dr. REMA MENON
MEMBER SECRETARY
ETHICS COMMITTEE, APOLLO HOSPITALS
APOLLO HOSPITALS ENTERPRISE LIMITED
CHENNAI-600 006, TAMILNADU

Date: 30/8/12

APPENDIX III

LETTER SEEKING PERMISSION FOR CONTENT VALIDITY

From

Ms. Famila Jane Christiana. Y
M.Sc(Nursing) Second Year,
Apollo College of Nursing,
Chennai – 600 095.

To

Forwarded Through:
Dr. Latha Venkatesan,
Principal,
Apollo College of Nursing.

Sub: **Requesting for opinions and suggestions of experts for establishing content validity for research tool**.

Respected Madam,

I am a postgraduate student of the Apollo College of Nursing. I have selected the below mentioned topic for research project to be submitted to The Tamil Nadu Dr. M.G.R Medical University, Chennai as a partial fulfillment of Masters of Nursing Degree.

TITLE OF THE TOPIC:

An evaluative study to assess the effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcomes in mechanically ventilated adult patients at selected hospitals, Chennai.

With regards may I kindly request you to validate my tool for its appropriateness and relevancy. I am enclosing the Background, Need for the study, Statement of the problem, Objectives of the study, Demographic Variable Proforma, Clinical Variable Proforma, observational checklist for respiratory outcome, practice of nurse's checklist and rating scale on the satisfaction of nurses. I would be highly obliged and remain thankful for your great help if you could validate and send it as soon as possible.

Thanking you,

Date: **Yours sincerely,**

Place: **(Famila Jane Christiana.Y)**

APPENDIX IV

LIST OF EXPERTS

1. **Dr. Latha Venkatesan, M.Sc(N), M.Phil (N)., Ph.D(N),**
   Principal and Professor in Maternity Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

2. **Prof. Lizy Sonia. A, M.Sc(N),**
   Vice Principal and Professor in Medical Surgical Nursing,
   Apollo College of Nursing,
   Chennai-600 095

3. **Prof. K. Vijayalakshmi, M.Sc(N),**
   Professor in Psychiatric Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

4. **Prof. Shobana, M.Sc(N),**
   Professor in Community Health Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

5. **Mrs. Nesa Sathya Satchi, M.Sc(N),**
   Professor in Pediatric Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

6. **Mrs. Jaslina Gnanarani .J, M.Sc(N),**
   Reader in Medical Surgical Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

7. **Mrs. Sasi Kala, M.Sc(N),**
   Reader in Medical Surgical Nursing
   Apollo College Of Nursing
   Chennai-600 095

8. **Mrs. Kanchana, M.Sc (N)., M.Sc(Psy),**
   Reader in Medical Surgical Nursing,
   Apollo College of Nursing,
   Chennai-600 095

9. **Mrs. Kasthuri, M.Sc (N),**
   Lecturer in Medical Surgical Nursing,
   Apollo College of Nursing,
   Chennai- 600 095

APPENDIX V

CERTIFICATE FOR CONTENT VALIDITY TO WHOMSOEVER IT MAY CONCERN

This is to certify that tools and content for the research study developed by II year M.Sc (Nursing) student of Apollo College of Nursing for her dissertation "An evaluative study to assess the effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcomes in mechanically ventilated adult patients at selected hospitals, Chennai" was validated.

Signature of the Expert

APPENDIX VI

RESEARCH PARTICIPANT CONSENT FORM

Dear participant/ bystander,

I am Famila Jane Christiana.Y, an M.Sc Nursing student of Apollo College of Nursing, Chennai. As a part of my study, a research on **Effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcome in mechanically ventilated adult patients.**

I hereby seek your consent and co-operation to participate in the study. Please be frank and honest in response. The information obtained will be kept confidential and anonymity will be maintained.

Signature of the researcher

I ……..Hereby consent to participate my relative in this study

Place:

Date:

Signature of the participant/ bystander.

APPENDIX VII

CERTIFICATE FOR ENGLISH EDITING

TO WHOMSOEVER IT MAY CONCERN

This to certify that the dissertation **"An evaluative study to assess the effectiveness of closed endotracheal suctioning as against open endotracheal suctioning upon respiratory outcomes in mechanically ventilated adult patients at selected hospitals, Chennai"** by Ms.Famila Jane Christiana.Y, II Year M.Sc. (N) student, Apollo College of Nursing, was edited for English language appropriateness.

Signature

Mr. G. GODSON BEDEIAH.
M.A; M.B.A; M.Phil,
ASSISTANT PROFESSOR,
DEPARTMENT OF ENGLISH,
VELAMMAL INSTITUTE OF
TECHNOLOGY

VELAMMAL INSTITUTE OF TECHNOLOGY * PANCHETTI *

APPENDIX VIII

PLAGIARISM DETECTOR ORIGINALITY REPORT

Plagiarism Detector - Originality Report

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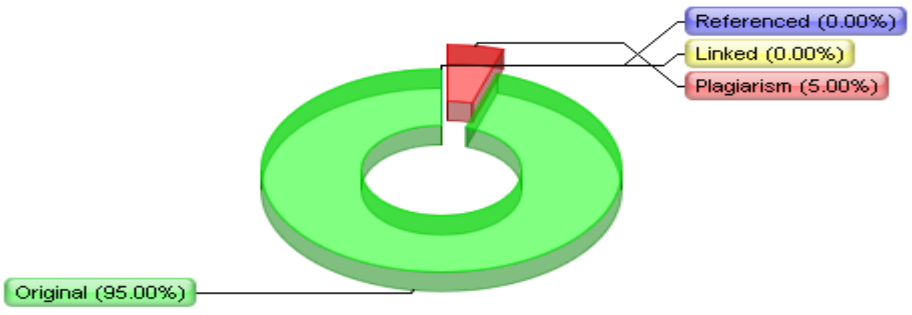

<=""">

Referenced 0% / Linked 0%

Original - 95% / 5% - Plagiarism

APPENDIX IX

DEMOGRAPHIC VARIABLE PROFORMA OF PATIENTS

Purpose

This proforma is used to measure the demographic variables of patient such as age, sex, occupation, place of work, nature of work and other source of health information.

Instructions

The researcher collects the following information from the relatives and records by asking question in the interview form and observation. Please be frank and free in answering, it will be kept confidential and anonymity will be maintained.

Sample no:

1. **Age in years**
   - 1.1 21-30 ☐
   - 1.2 31-40 ☐
   - 1.3 41-50 ☐
   - 1.4 51-60 ☐
2. **Sex**
   - 2.1 Male ☐
   - 2.2 Female ☐
3. **Occupation**
   - 3.1 Employed ☐
   - 3.2 Unemployed ☐
   - 3.3 Home maker ☐
   - 3.4 Retired ☐

4. Place of work

4.1 Indoor ☐

4.2 Outdoor ☐

5. Nature of work

5.1 Sedentary worker ☐

5.2 Moderate worker ☐

5.3 Heavy worker ☐

6. History of smoking

6.1 Yes ☐

6.2 No ☐

7. History of alcoholism

7.1 Yes ☐

7.2 No ☐

APPENDIX X

CLINICAL VARIABLE PROFORMA FOR PATIENTS IN MECHANICAL VENTILATOR SUPPORT

Purpose

This proforma is used to assess the clinical variables such as past medical and surgical history, airway pattern, ventilator days and other health related information.

Instructions

The researcher collects the following information from the relatives and records by asking questions in the interview form and observation. Please be frank and free in answering. It will be kept confidential and anonymity will be maintained.

1. **Diagnosis (specify)**
   - 1.1 Respiratory disease ☐
   - 1.2 Cardiovascular disease ☐
   - 1.3 Neurological disease ☐
   - 1.4 Gastrointestinal disease ☐
   - 1.5 Others ☐
2. **Reason for mechanical ventilation**
   - 2.1 Respiratory failure ☐
   - 2.2 Disease condition that prevents normal breathing ☐
   - 2.3 Trauma/ shock ☐
   - 2.4 Others (specify) ☐

3 Body mass index

3.1 Underweight ☐

3.2 Normal weight ☐

3.3 Overweight ☐

3.4 Obesity ☐

4 No of days on ventilator support

4.1 1 to 3 days ☐

4.2 4 to 6 days ☐

4.3 More than 6 days ☐

5 Alertness of patient

5.1 Conscious ☐

5.2 Sedated/paralyzed ☐

6 Vacuum pressure level during suctioning

6.1 10-100mmhg ☐

6.2 101-200mmhg ☐

6.3 201-300mmhg ☐

7 Whether patient undergoing chest physiotherapy

7.1 Yes ☐

7.2 No ☐

8 Presence of humidifier

8.1 Yes ☐

8.2 No ☐

9 Use of nebulization

9.1 Yes ☐

9.2 No ☐

10. Is there any previous history of any respiratory illness

10.1Yes(if yes specify) ☐

10.2 No ☐

11. Presence of co-morbid illness

11.1Yes (if yes specify) ☐

11.2No ☐

12. Treatment of co-morbid illness

12.1Yes (if yes specify) ☐

12.2 No ☐

13. Is there any history of trauma/accident?

13.1Yes (if yes specify) ☐

13.2 No ☐

14. History of any surgeries in the past?

14.1Yes (if yes specify) ☐

14.2 No ☐

BLUE PRINT ON

BLUE PRINT ON OBSERVATIONAL CHECK LIST TO ASSESS THE RESPIRATORY OUTCOME AFTER CLOSED AND OPEN ENDOTRACHEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

S.No	Categories	Items	Total Items	Percentage
1	Vital signs	2,10,11,13	4	26.7%
2	Signs of respiratory distress	1,3,4,8,9	5	33.3%
3	Ventilator settings	5,6,7	3	20%
4	Sign of Infection	12,14,15	3	20%
	Total	-	15	100%

APPENDIX XI

OBSERVATIONAL CHECKLIST TO ASSESS THE RESPIRATOTY OUTCOME FOR PATIENTS AFTER CLOSED AND OPEN ENDOTRACHEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

Purpose

This checklist provides information regarding the respiratory outcome for patients after closed and open endotracheal suctioning in mechanically ventilated adult patients.

Instruction:

There are items given below. Kindly read the items and record accordingly.

Score 0 – Major variation in parameter

Score1 – Moderate variation in parameter

Score 2 – Mild variation in parameter

Score 3 – No variation in parameter

S.NO	Patients respiratory outcome	Scores			
		0	**1**	**2**	**3**
1	**Oxygenation**	Oxygen saturation less than 90%	Oxygen saturation between 91-94%	Oxygen saturation between 95-97%	Oxygen saturation between 98-100%
2	**Respiratory rate**	Respiration rate > 41 breaths/mt and less than 16 breaths/mt	Respiratory rate 33-40 breaths/mt	Respiratory rate 25-32 breaths/mt	Respiratory rate 16-24breaths/mt
3	**Breath sounds**	Presence of wheezing, crepts, crackles and rhonchi	Presence of wheezing and rhonchi	Presence of wheezing	Normal vesicular breath sounds
4	**Use of accessory muscles**	Movements coordinated with the ventilator	Use of abdominal muscles	More strenuous muscle usage	Normal
5	**FiO_2**	FiO_2 more than 80%	FiO_2 between 61-80%	FiO_2 between 41-60%	FiO_2 less than 40%
6	**Tidal volume**	Tidal volume more than 16ml/kg and less than 4ml/kg	Tidal volume 13-16 ml/kg	Tidal volume 9-12ml/kg	Tidal volume 4-8ml/kg
7	**PIP (peak inspiratory pressure)**	PIP less than 9cm H_2O	PIP between 10-14cm H_2O	PIP between 15-19cm H_2O	20cmH_2O

8	**PaO_2 (partial pressure of arterial oxygenation)**	PaO_2 Less than 71mmhg	PaO_2 Between 71-80mmhg	PaO_2 Between 81-90mmhg	PaO_2 Between 91-100mmhg
9	**$PaCO_2$ (partial pressure of arterial carbon dioxide)**	$PaCO_2$ More than 56mmhg and less than 35mmhg	$PaCO_2$ Between 51-55 mmhg	$PaCO_2$ Between 46-50 mmhg	$PaCO_2$ Between 35-45mmhg
10	**Blood pressure**	BP More than 150/100 mmhg Less than 110/70	BP between 131- 149 mmhg systolic and 91-99mmhg diastolic	BP between 121- 130 mmhg systolic and 81-90mmhg diastolic	BP 110-120 mmhg systolic and 70 -80 mmhg diastolic
11	**Heart rate**	Pulse rate > 120 beats/ mt and <60beats/ mt	Pulse rate between 101 - 120beats/ mt	Pulse rate between 81-100 beats/ mt	Pulse rate between 61-80 beats /mt
12	**No of days in ventilator**	More than 6 days	5-6days	3-4 days	1-2days
13	**Temperature**	Temperature More than 103.1^0F	Temperature Between 101^0 -103^0F	Temperature Between 98.5^0 – 100.9^0 F	Temperature less than 98.4^oF

14	**Characteristics of secretion**	Thick yellow or green copious secretion with odour	Thick more secretion with no odour	Thin more watery secretion with no odour	Normal secretion with minimal discharge and no odour
15	**ET culture**	Positive (gram negative organism and fungal infection)	Positive (gram positive organism)	Few pus cells noted	Negative

Scoring key

1-25% - Highly Negative Outcome

25.1-50% - Negative Outcome

50.1-75% - Positive Outcome

75.1-100% - Highly Positive Outcome

BLUE PRINT ON

RATING SCALE ON SATISFACTION OF NURSES FOR CLOSED AND OPEN ENDOTRACHEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

S.No	Content	Items	Total Items	Percentage
1.	Environment	1,3,13,15	4	25%
2.	Method applicability	2,5,8,11	4	25%
3.	Patient's benefit	4,6,9,12	4	25%
4.	Researcher's approach	7,10,14,16	4	25%
	Total	**--**	**16**	**100%**

APPENDIX XII

RATING SCALE ON LEVEL OF SATISFACTION OF NURSES FOR CLOSED AND OPEN ENDOTRAHCEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

Purpose

The rating scale is designed to assess the level of satisfaction of the nurses regarding the closed endotracheal suction suctioning and open endotracheal suctioning in mechanically ventilated adult patients.

Instruction

There are items given below. Kindly read the items. Responses extend from highly satisfied to dissatisfy. Describe your satisfaction regarding nursing care. Give your responses freely and frankly. The responses will be kept confidential.

Scoring key:

Highly Satisfied -2

Satisfied -1

Dissatisfied -0

S.No	Items	Highly Satisfied	Satisfied	Dissatisfied
1.	Are you satisfied with the bed side environment & ease in handling instruments during the procedure?			
2.	Whether you were satisfied with the method of suctioning followed?			
3.	Are you comfortable while performing the procedure?			

4.	Are you satisfied with the outcome of patients?			
5.	Are you satisfied with the type of suctioning used?			
6.	Whether you were able to follow strict aseptic technique?			
7.	Are you able to follow all the theoretical & technical principles during suction?			
8.	Are you able to maintain personal protection while performing the procedure?			
9.	Are you satisfied with the cost effectiveness of the procedure?			
10.	Are you satisfied with the level of oxygen saturation during suction?			
11.	Are you satisfied with the duration and timing while performing suction procedure?			
12.	Are you satisfied with the procedure in view of reducing the infection rate in patients?			
13.	Are you able to maintain the body mechanics while performing the suction?			
14.	Whether the vital signs were within the normal limits during suction			
15.	Whether you were satisfied with the minimal use of additional articles need to use during suction?			

16.	Whether you were satisfied with the researchers approach, way of explanation and adequate information given?			

Score Interpretation

<50% - Dissatisfied

50-75% - Satisfied

>75% - Highly satisfied

BLUE PRINT ON PRACTICE OBSERVATIONAL CHECKLIST OF NURSES WHILE PERFORMING CLOSED AND OPEN ENDOTRACHEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

S.No	Content	Items	Total Items	Percentage
1	Preparation	1,2,3,4,13	5	33.3%
2	Skill	5,6,7,8,9	5	33.4%
3	Evaluation	10,11,12,14,15	5	33.3%

APPENDIX XIII

PRACTICE OBSERVATIONAL CHECKLIST OF NURSES WHILE PERFORMING CLOSED AND OPEN ENDOTRACHEAL SUCTIONING IN MECHANICALLY VENTILATED ADULT PATIENTS

Purpose

This checklist provides information regarding the practice of nurses while performing closed and open endotracheal suctioning in mechanically ventilated adult patients.

Instructions

The researcher collects the following information from the nurses by observing while performing the procedure. The information will be kept confidential and anonymity will be maintained.

Scoring key:

Done	-2
Partially done	-1
Not done	-0

S.no	Items	Done	Partially done	Not done
1	Hand wash/ hand rub			
2	Explaining the procedure to patient			
3	Personal protection articles (gloves and mask)			
4	Pre preparation of articles			
5	Preoxygenation			
6	Instillation of water			
7	Depth of suction			
8	Sterile technique			
9	Circulatory movements while suctioning			
10	Oxygenation between the procedure			
11	Using yanker for oral suction			
12	Flushing the suction catheter after procedure.			
13	Time of stopping feed			
14	Duration of suctioning			
15	Recording			

Score Interpretation

<50%	-	Poor performance
50-75%	-	Average performance
>75%	-	Good performance

APPENDIX XIV
DATA CODE SHEET

Age in years	**AG**
20-30 yrs	1
31-40yrs	2
41-50yrs	3
51-60 yrs	4
Sex	**SX**
Male	1
Female	2
Occupation	**OC**
Employed	1
Unemployed	2
Home maker	3
Retired	4
Place of work	**PC**
Indoor	1
Outdoor	2
Nature of work	**NW**
Sedentary worker	1
Moderate worker	2
Heavy worker	3
History of smoking	**HS**
Yes	1
No	2
History of alcoholism	**HA**
Yes	1
No	2
Diagnosis	**DG**
Respiratory disease	1
Cardiovascular disease	2
Neurological disease	3
Gastrointestinal disease	4
Others	5

Reason for mechanical ventilation	**RM**
Respiratory failure	1
Disease condition that prevents normal breathing	2
Trauma/ shock	3
Others	4

Body mass index	**BM**
Underweight	1
Normal	2
Overweight	3
Obesity	4
No of days in ventilator	**ND**
1 to 3 days	1
4 to 6 days	2
More than 6 days	3

Alertness of patient	**AT**
Conscious	1
Sedated	2
Vacuum pressure	**VP**
1 to 100mmhg	1
101 to 200 mmhg	2
201 to 300mmhg	3
Chest physiotherapy	**CP**
Yes	1
No	2
Humidifier	**HM**
Yes	1
No	2
Nebulization	**NB**
Yes	1
No	2
History of past respiratory illness	**HRI**
Yes	1
No	2
Presence of co morbid illness	**HCI**
Yes	1
No	2
Treatment of comorbid illness	**RCI**
Yes	1
No	2
History of trauma	**HT**
Yes	1
No	2
History of Past surgery	**PS**
Yes	1
No	2

Level of satisfaction		**LS**
1 to 10	Dissatisfied	
11 to 20	Satisfied	
21 to 32	Highly satisfied	

Level of practice of nurses		**PN**
1 to 10	Poor performance	
11 to 20	Average performance	
21 to 30	Good performance	

Respiratory outcome	
Pre observation	**P0**
During suction	**At**
5min after suction	**5M**
15min after suction	**15M**

APPENDIX XV

MASTER CODING SHEET- CLOSED ENDOTRACHEAL SUCTIONING

S.NO	DEMOGRAPHIC VARIABLE							CLINICAL VARIABLE															RESPIRATORY OUTCOME				LS	PN
	AG	SX	OC	PW	NW	HS	HA	DG	RM	BM	ND	AT	VP	CP	HM	NB	HRI	HCI	RCI	HT	HS	PO	AT	5M	15M		
1	1.1	2.1	3.1	4.2	5.3	6.2	7.1	1.3	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.1	10.2	11.2	12.2	13.1	14.2	37	31	36	38	23	19
2	1.3	2.1	3.1	4.2	5.2	6.2	7.2	1.5	2.3	3.1	4.2	5.2	6.3	7.2	8.2	9.1	10.2	11.2	12.2	13.2	14.2	27	22	26	28	23	19
3	1.4	2.1	3.1	4.2	5.3	6.2	7.2	1.3	2.2	3.3	4.1	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	37	29	36	37	16	19
4	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.3	2.2	3.3	4.1	5.2	6.3	7.2	8.2	9.1	10.2	11.2	12.2	13.2	14.2	36	31	36	36	17	20
5	1.1	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.2	4.1	5.2	6.3	7.2	8.1	9.2	10.2	11.2	12.2	13.1	14.2	31	27	29	34	20	21
6	1.4	2.1	3.1	4.1	5.2	6.1	7.1	1.1	2.1	3.1	4.1	5.2	6.3	7.2	8.1	9.1	10.2	11.1	12.1	13.2	14.1	25	21	24	25	23	23
7	1.4	2.1	3.4	4.1	5.1	6.1	7.1	1.4	2.2	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	39	34	37	39	18	20
8	1.2	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.3	3.2	4.1	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.2	25.6	21.6	25.6	24.6	19	21
9	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.3	2.4	3.2	4.3	5.1	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	36	31	32	36	19	18
10	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.4	3.1	4.1	5.2	6.3	7.2	8.2	9.1	10.1	11.1	12.1	13.2	14.2	31	29	32	32	22	18
11	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.3	2.2	3.1	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.1	29.6	25.6	29.6	29.6	19	24
12	1.2	2.2	3.1	4.1	5.1	6.2	7.2	1.1	2.3	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.2	26.3	21.3	25.3	26.3	20	20
13	1.4	2.1	3.1	4.2	5.2	6.2	7.2	1.5	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	35	29	34	35	16	20
14	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.2	2.3	3.1	4.3	5.2	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	33	28	33	35	19	22
15	1.3	2.1	3.1	4.2	5.3	6.2	7.1	1.4	2.1	3.1	4.3	5.1	6.3	7.2	8.1	9.2	10.2	11.2	12.2	13.2	14.2	31	25	30	31	19	20
16	1.3	2.1	3.4	4.1	5.1	6.1	7.2	1.3	2.2	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	27.6	22.6	26.6	27.6	15	23
17	1.4	2.1	3.1	4.2	5.3	6.1	7.1	1.4	2.4	3.1	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	39	34	38	39	21	23
18	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.5	2.4	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	37	33	37	38	22	23
19	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.2	2.2	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	29	24	29	30	16	21
20	1.4	2.1	3.1	4.1	5.2	6.2	7.2	1.4	2.4	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	43	40	43	40	25	23
21	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.2	2.1	3.3	4.1	5.2	6.3	7.1	8.2	9.1	10.2	11.2	12.2	13.2	14.2	34	28	34	37	15	24
22	1.4	2.1	3.4	4.1	5.1	6.1	7.1	1.5	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.1	10.2	11.1	12.1	13.2	14.1	39.6	33.6	39.6	36.6	18	18
23	1.3	2.2	3.1	4.2	5.2	6.2	7.1	1.4	2.4	3.4	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	35	28	35	39	23	19
24	1.3	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.4	3.4	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	37.6	33.6	36.6	37.6	24	23
25	1.2	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.2	4.2	5.1	6.3	7.1	8.2	9.1	10.2	11.2	12.2	13.1	14.2	30	25	29	30	29	20
26	1.2	2.1	3.1	4.2	5.3	6.2	7.2	1.3	2.2	3.3	4.1	5.2	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	34	29.6	33.6	36	23	14
27	1.2	2.1	3.1	4.1	5.2	6.2	7.2	1.3	2.2	3.3	4.1	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.1	34	29	34	34	20	21
28	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.2	2.3	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.1	33	27	33	36	18	22
29	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.1	2.1	3.4	4.1	5.1	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	37	32	36	38	20	23
30	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.1	2.1	3.3	4.2	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.1	32.3	30.3	34.3	35.3	18	22
31	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.2	2.1	3.2	4.2	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	33	28	32	34	23	20
32	1.3	2.2	3.1	4.2	5.2	6.1	7.2	1.4	2.1	3.1	4.1	5.2	6.3	7.2	8.2	9.1	10.1	11.1	12.1	13.2	14.2	33	28	32	33	19	21
33	1.1	2.2	3.2	4.1	5.1	6.2	7.2	1.5	2.4	3.2	4.1	5.1	6.3	7.2	8.2	9.2	10.1	11.2	12.2	13.2	14.2	37	30	36	37	23	25
34	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.2	2.1	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	33	26	32	36	19	21
35	1.2	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.4	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	35	30	35	36	18	23
36	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.2	2.3	3.2	4.1	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.2	30.3	23.3	29.3	29.3	16	19
37	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.3	2.2	3.1	4.2	5.1	6.3	7.2	8.1	9.1	10.2	11.1	12.1	13.2	14.1	32	26	31	38	31	18
38	1.2	2.2	3.3	4.1	5.1	6.2	7.2	1.1	2.1	3.3	4.1	5.2	6.3	7.1	8.1	9.1	10.1	11.1	12.1	13.2	14.2	28	22	26	30	23	20
39	1.1	2.1	3.1	4.2	5.3	6.2	7.1	1.2	2.1	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	39	33	38	37	32	21
40	1.2	2.1	3.1	4.2	5.3	6.1	7.1	1.4	2.2	3.2	4.1	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.1	34	30	34	36	19	24
41	1.3	2.2	3.1	4.2	5.2	6.2	7.2	1.5	2.4	3.2	4.2	5.2	6.3	7.2	8.1	9.2	10.2	11.2	12.2	13.2	14.2	32	31	35	35	14	20
42	1.2	2.1	3.1	4.2	5.3	6.1	7.1	1.3	2.2	3.3	4.1	5.2	6.3	7.2	8.2	9.1	10.1	11.2	12.2	13.2	14.2	35.6	30.6	33.6	37.6	22	19
43	1.3	2.1	3.1	4.1	5.2	6.2	7.2	1.5	2.4	3.2	4.3	5.2	6.3	7.2	8.2	9.1	10.2	11.1	12.1	13.2	14.2	24	18	21	27	17	21
44	1.2	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.4	4.2	5.2	6.3	7.2	8.2	9.1	10.2	11.2	12.2	13.1	14.2	26	25	26	25	25	21
45	1.4	2.1	3.4	4.1	5.1	6.2	7.1	1.3	2.3	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.1	14.1	34	28	32	37	22	16
46	1.4	2.1	3.4	4.1	5.2	6.1	7.1	1.1	2.2	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.1	26	23	27	27	20	19
47	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.1	2.1	3.1	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.2	14.2	29	25	29	29	17	20
48	1.1	2.2	3.2	4.1	5.1	6.2	7.2	1.3	2.3	3.2	4.1	5.1	6.3	7.2	8.1	9.2	10.2	11.2	12.2	13.1	14.2	38	36	38	44	16	21
49	1.4	2.1	3.4	4.2	5.1	6.2	7.2	1.4	2.4	3.1	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	41	37	42	42	19	26
50	1.3	2.1	3.1	4.1	5.2	6.2	7.2	1.5	2.4	3.2	4.3	5.1	6.3	7.1	8.2	9.1	10.2	11.2	12.2	13.2	14.1	32	30	32	33	25	20

MASTER CODING SHEET – OPEN ENDOTRACHEAL SUCTIONING

S.NO	DEMOGRAPHIC VARIABLE							CLINICAL VARIABLE														RESPIRATORY OUTCOME				LS	PN
	AG	SX	OC	PW	NW	HS	HA	DG	RM	BM	ND	AT	VP	CP	HM	NB	HRI	HCI	RCI	HT	HS	PO	AT	5M	15M		
1	1.2	2.1	3.1	4.2	5.3	6.2	7.2	1.1	2.1	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	36	25	34	37	26	25
2	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.1	3.3	4.1	5.2	6.3	7.1	8.2	9.1	10.2	11.2	12.2	13.2	14.1	35.6	27.6	33.6	35.6	19	19
3	1.4	2.1	3.2	4.2	5.2	6.2	7.2	1.5	2.4	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	39	34	38	39	27	19
4	1.4	2.1	3.4	4.2	5.1	6.2	7.1	1.3	2.4	3.4	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	32	24	32	33	22	18
5	1.1	2.1	3.1	4.2	5.1	6.2	7.2	1.3	2.3	3.3	4.1	5.2	6.3	7.1	8.2	9.2	10.2	11.2	12.2	13.1	14.2	31.6	21.6	31.6	31.6	24	22
6	1.4	2.1	3.4	4.1	5.1	6.1	7.2	1.3	2.2	3.2	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	31	24	31	31	24	22
7	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.5	2.4	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	27	20	26	29	26	16
8	1.1	2.1	3.1	4.1	5.2	6.2	7.2	1.5	2.4	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.2	13.2	14.2	33	28	33	33	21	18
9	1.2	2.1	3.1	4.2	5.3	6.1	7.1	1.3	2.2	3.1	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.1	14.1	32	25	31	31	26	16
10	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.2	3.3	4.2	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.1	31	22	31	31	22	17
11	1.3	2.1	3.1	4.2	5.3	6.2	7.2	1.3	2.2	3.1	4.1	5.2	6.3	7.2	8.2	9.1	10.1	11.2	12.2	13.2	14.2	35.6	29.6	35.6	38.6	25	18
12	1.4	2.1	3.4	4.1	5.2	6.2	7.2	1.3	2.4	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	35.6	28.6	35.6	37.6	30	20
13	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.1	2.1	3.4	4.1	5.1	6.3	7.2	8.1	9.1	10.2	11.1	12.1	13.2	14.2	34.6	26.6	33.6	33.6	26	19
14	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	30	24	29	29	30	20
15	1.3	2.2	3.1	4.1	5.1	6.2	7.2	1.1	2.4	3.1	4.2	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.1	25	15	24	25	16	16
16	1.4	2.1	3.2	4.1	5.1	6.2	7.2	1.5	2.1	3.1	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	34	28	34	31	23	19
17	1.3	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.4	3.1	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	36	26	36	36	14	19
18	1.2	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.2	13.1	14.2	32	22	31	37	17	18
19	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.3	2.3	3.2	4.1	5.2	6.3	7.2	8.2	9.1	10.1	11.1	12.1	13.1	14.2	32	22	30	31	19	18
20	1.1	2.1	3.2	4.1	5.1	6.1	7.2	1.3	2.2	3.2	4.1	5.2	6.3	7.1	8.2	9.2	10.2	11.2	12.2	13.2	14.2	33	23	33	32	22	20
21	1.2	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.1	14.2	38.3	29.3	38.3	38.3	20	16
22	1.1	2.1	3.1	4.2	5.3	6.2	7.1	1.3	2.3	3.3	4.2	5.2	6.3	7.2	8.1	9.1	10.2	11.2	12.2	13.1	14.2	24	14	22	24	22	19
23	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.2	3.3	4.2	5.2	6.3	7.2	8.2	9.1	10.2	11.1	12.1	13.2	14.1	33.6	24.6	33.6	30.6	22	18
24	1.2	2.1	3.1	4.2	5.2	6.2	7.2	1.3	2.3	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.1	14.1	32	22	31	35	17	18
25	1.2	2.1	3.1	4.2	5.3	6.1	7.1	1.3	2.2	3.3	4.3	5.1	6.3	7.1	8.1	9.1	10.2	11.2	12.2	13.1	14.1	33	22	31	32	19	21
26	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.2	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.1	14.2	33	23	32	36	20	14
27	1.1	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.3	3.2	4.3	5.1	6.3	7.1	8.2	9.1	10.2	11.2	12.2	13.1	14.2	30	21	30	36	23	23
28	1.2	2.1	3.1	4.2	5.2	6.1	7.2	1.3	2.3	3.2	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.1	14.2	33	24	33	39	28	24
29	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.4	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.1	35	26	35	41	23	19
30	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.4	2.2	3.1	4.2	5.2	6.3	7.1	8.1	9.1	10.2	11.1	12.1	13.2	14.2	29.6	22.6	28.6	30.6	16	21
31	1.2	2.1	3.1	4.2	5.3	6.1	7.2	1.5	2.3	3.3	4.2	5.2	6.3	7.2	8.1	9.1	10.2	11.2	12.2	13.1	14.2	36	26	34	38	24	26
32	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.3	3.3	4.1	5.1	6.3	7.2	8.2	9.1	10.2	11.1	12.1	13.2	14.2	38.6	29.6	37.6	38.6	21	18
33	1.3	2.1	3.1	4.2	5.2	6.2	7.2	1.5	2.2	3.2	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	26	17	26	32	18	15
34	1.2	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.2	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	38	32	37	40	18	20
35	1.2	2.1	3.1	4.2	5.2	6.2	7.2	1.3	2.3	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.1	14.2	38	29	37	38	19	18
36	1.1	2.1	3.2	4.1	5.1	6.1	7.1	1.3	2.3	3.2	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	39	33	39	39	15	22
37	1.1	2.1	3.2	4.1	5.1	6.2	7.2	1.3	2.3	3.2	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	38.6	27.6	37.6	37.6	11	19
38	1.3	2.1	3.1	4.1	5.2	6.2	7.2	1.3	2.4	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	40	34	39	37	18	22
39	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.3	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	35	26	35	34	15	21
40	1.4	2.1	3.1	4.1	5.1	6.2	7.2	1.3	2.4	3.3	4.1	5.1	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	34.3	24.3	31.3	33.3	23	18
41	1.1	2.1	3.2	4.1	5.1	6.2	7.2	1.3	2.3	3.3	4.1	5.2	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.1	14.2	32	25	31	32	20	17
42	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.4	2.2	3.3	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.1	12.1	13.2	14.2	35	28	34	34	21	21
43	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.5	2.4	3.3	4.2	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.1	37	27	35	37	23	19
44	1.3	2.1	3.1	4.2	5.2	6.1	7.2	1.4	2.4	3.3	4.1	5.1	6.3	7.2	8.1	9.2	10.2	11.2	12.2	13.2	14.2	36	24	33	36	12	18
45	1.4	2.1	3.4	4.1	5.1	6.2	7.2	1.3	2.2	3.2	4.1	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	40.3	31.3	39.3	43.3	25	19
46	1.4	2.2	3.3	4.1	5.1	6.2	7.2	1.4	2.3	3.1	4.1	5.2	6.3	7.1	8.2	9.1	10.1	11.1	12.1	13.2	14.2	30	22	29	32	24	20
47	1.4	2.2	3.1	4.2	5.1	6.2	7.2	1.5	2.4	3.3	4.1	5.1	6.3	7.2	8.2	9.1	10.2	11.1	12.1	13.2	14.1	33	25	32	33	20	20
48	1.3	2.1	3.1	4.2	5.2	6.2	7.2	1.3	2.2	3.3	4.1	5.1	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.1	35.6	26.6	35.6	39.6	14	22
49	1.3	2.1	3.1	4.2	5.2	6.1	7.1	1.3	2.2	3.3	4.1	5.2	6.3	7.1	8.2	9.1	10.2	11.1	12.1	13.2	14.2	27	18	26	28	17	21
50	1.1	2.2	3.2	4.1	5.1	6.2	7.2	1.3	2.2	3.2	4.1	5.1	6.3	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.1	33	25	29	27	19	21

APPENDIX XVI

PHOTOGRAPHS DURING ENDOTRACHEAL SUCTIONING


MAQUET